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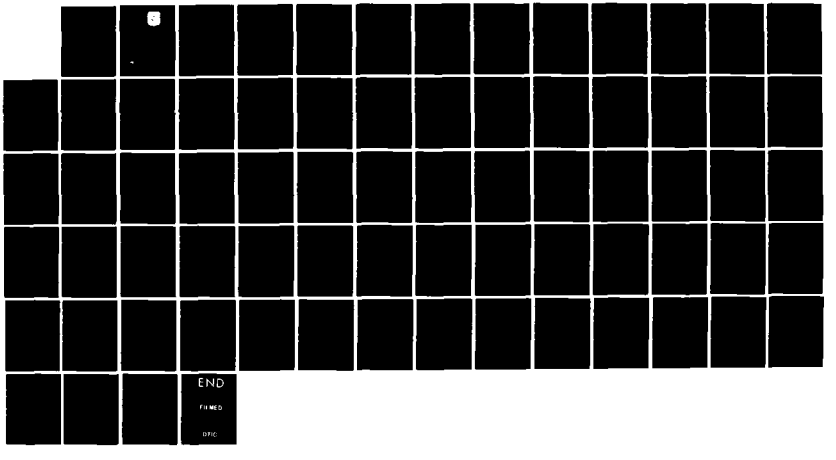

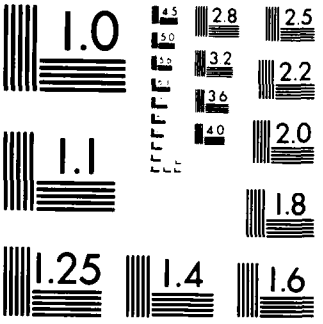

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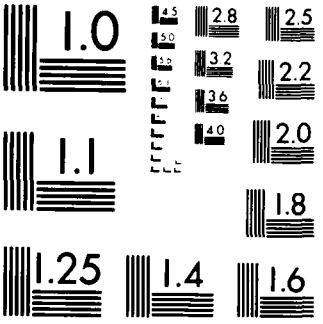

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DEFENSE COMMUNICATIONS AGENCY

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The theme of this individual study project is to arrive at possible Army roles in theater-wide communications. Today one can see that tactical elements (i.e., echelons at corps and below) are being equipped with organic communications equipment which is necessary to fight the battle. Relatively thin lines of long-haul communications interconnect out-of-theater. Within the theater, between tactical elements and the long haul communications, are mostly peacetime systems which cannot provide survivability and endurability during wartime.

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USAWC MILITARY STUDIES PROGRAM

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INDIVIDUAL STUDY PROJECT

by

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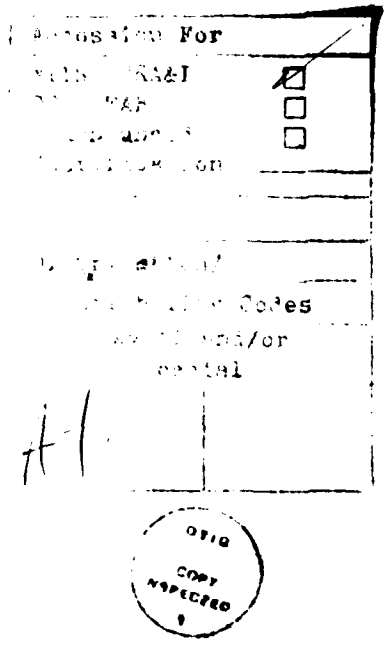
PREFACE

This project is a research paper compiled in the Military Studies Program at the US Army War College. The intent is to establish a baseline of understanding on theater communications so possible Army roles can emerge as a basis for study in any follow on communications architectures, which might be conducted anywhere in the Department of Defense. The author of the paper elected to develop this subject based on extensive field experience in the Pacific, Southeast Asia and European theaters in supplement with similar experience in planning for the Southwest Asia theater. The paper is also written with a minimization of communications jargon to permit reading at a wide level and in various professional disciplines.



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CHAPTER 1

INTRODUCTION

BACKGROUND

This study attempts to establish a baseline of understanding on theater communications so one or more roles for the Army c . viewed. Theater communications is defined as the communications network within a theater but to the exclusion of equipment which is organic to and serves the users of tactical elements (i.e., corps and below). The system elements within the theater which connect to the out-of-theater communication paths come under the control of the theater commander only in time of war, not peace. One could then postulate, "but what else is left?" The answer is "not much." The Military Departments continue to not recognize the importance of a survivable and endurable communications system in the long distance, theater-wide area. The individual services primarily limit their concerns to the requirements of their own Military Department while only a few other agencies and organizations look at a joint system approach.

This project seeks to address the different concepts of an Army only communications system within a theater and of a joint integrated, theater-wide system. While numerous concept studies have been accomplished over the years for integrated theater networks, an effective way of implementation has not emerged. This project is not an implementation or installation plan. Instead it identifies the need for communications architectures to be developed. In addition it enjoins the

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Military Departments to view collectively the advantages of joint systems, particularly in the environment of competing needs for resource allocation. It is time to draw things together for a good hard look at some of the historical efforts in conjunction with further research and a link into the AirLand Battle doctrine.

STATEMENT OF THE PROBLEM

The problem is basically that doctrine and communications systems requirements today cannot be effectively supported by the existing communications capabilities. The most critical impact of this failure is at the operational level. A communications system is needed within a theater to permit the Commander-in-Chief (CINC) to exercise command and control effectively. The system must be survivable and endurable. Survivable implies the ability to maintain an operational capability during the early stages of a wartime situation. Endurable implies the ability to continue to satisfy the communications needlines during the battle as parts of the system are disrupted. Although these words are the statement of the problem, one cannot appreciate the significance without expanding further to see both the past and current work efforts on the problem.

Currently there is a wide variance in the approaches to the problem depending upon the organization to which one belongs. The Army and Air Force have thus far addressed communications within the theater from a service standpoint primarily. The Defense Communications Agency (DCA), in response to tasking by the Joint Chiefs of Staff, is addressing an integrated theater-wide system rather than separate systems for each service. DCA has been working with other agencies and selected theater CINCs to develop a Joint Multichannel Trunking and

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Table II-1. Southeast Asia Tandem Switching System. 28

Switching System which fulfills the Required Operational Capability (ROC) of each CINC. Three ROCs have been completed for several years now. The end result should be three communications architectures/system designs. Each would be optimized for one of the three theaters in the project, Western Europe, Southwest Asia, Pacific and then integrated from a global viewpoint. However, some current thinking concludes that these theater ROCs should be studied in greater detail, perhaps through a combination of ROCs within a theater. If this latter occurs, it does not appear as if any gains will have been made to solve the problem in theater-wide communications. Too often in the Defense Department, equipment is procured from a variety of vendors under a variety of specifications, and then an attempt is made to create a system from these subsystems. Students of General Systems Theory are well aware that to be effective, goals and objectives have to be established top down and not merely aggregated from numerous subsystems. Theater unique principles exist in this fashion, with few universal or system principles.

Another part of the problem deals with equipment technology. There is still equipment in the Army inventory from the Army Area Communications System, and its successor, the Integrated Tactical Communications System. The networking of these older generation systems creates some problems. Newer systems continue to be a part of the same problems. For example, the tactical, ruggedized equipment under procurement as the Tri-Service Tactical Communications family of equipment has numerous difficulties. These difficulties range through incompatibilities, high costs, outdated technologies, insufficient throughput capacities to name a few. Other possibilities to obtain equipment include: buying commercial equipment and adapting it to a mobile military environment; using

CHAPTER 1

INTRODUCTION

BACKGROUND

This study attempts to establish a baseline of understanding on theater communications so one or more roles for the Army c[illegible] viewed. Theater communications is defined as the communications network within a

equipment procured from allies; and even starting new programs within the Defense Department. Each of these ideas has its own set of difficulties and none are easily overcome. It seems then that a part of the problem is "where do we go from here in choosing the proper equipment technology?"

Other aspects of the problem include: the lack of importance apparently given to the reconstitution of peacetime and wartime communications systems; the hardening of fixed facilities; the use of mobile equipment; and overcoming the many deficiencies of past concepts and doctrine in theater communications systems.

Hopefully, the statement of the problem that current requirements cannot be met by current capabilities in theater communications is illuminated further after viewing the different approaches to solving the problem, seeing the current quandary with equipment technology and noting the other aspects of the problem which are to be developed later in the paper.

INVESTIGATIVE PROCEDURES

The data collection and analysis for this type of project requires the establishment of the overall framework for such a research effort. Data is then collected on the key foci in this framework and arranged in form for analysis to support the development of conclusions and recommendations for the Army role in theater communications. The guidelines for the data collection are progressively based on the following key foci:

- o The tasking from the Joint Chiefs of Staff to the CINCs, Defense Agencies, and Military Departments for the formulation of a

communications architecture/system design for the Commander-in-Chief Europe (CINCEUR), the Commander-in-Chief-Readiness Command (CINCRED) and the Commander-in-Chief Pacific (CINCPAC). Note that the scenario for CINCRED is actually the Southwest Asia theater which passes to the Commander-in-Chief Central Command (CINCCENT) since the conversion of the Rapid Deployment Joint Task Force (RDJTF) to the Central Command (CENTCOM).

- The Required Operational Capability (ROC) from CINCEUR, CINCCENT and CINCPAC. Therein are stated the CINC requirements which would ensure the establishment of a survivable and endurable system for command, control and communications.
- A review of the communications needlines in each of these theaters. For CINCEUR and CINPAC a deductive analysis of existing circuit requirements has been in progress for several years in an attempt to validate these needlines. For CINCCENT an inductive analysis has been accomplished in an attempt to identify communications needlines and the circuits which would be required to support these needlines. The Defense Communications Agency has been coordinating this work effort with the CINCs, component commanders of the individual Military Departments (MILDEPS), the communications commands of the MILDEPS and the communications and electronics elements of the MILDEP headquarters.
- The work effort of the Army, which is primarily the echelons above corps. The time period ranges from January 1970 when the US Army Combat Developments Command published a study entitled "Echelons Above Division."[1] The time period continued through 1976; the Theater Army Support Command and the Materiel Command were abolished to include field manuals and documents.[2]

Switching System which fulfills the Required Operational Capability (ROC) of each CINC. Three ROCs have been completed for several years now. The end result should be three communications architectures/system designs. Each would be optimized for one of the three theaters in the project, Western Europe, Southwest Asia, Pacific and then integrated from a global viewpoint. However, some current thinking concludes that these theater ROCs should be studied in greater detail, perhaps through a combination of ROCs within a theater. If this latter occurs, it does not appear as if any gains will have been made to solve the problem in theater-wide communications. Too often in the Defense Department, equipment is procured from a variety of vendors under a variety of specifications, and then an attempt is made to create a system from these subsystems. Students of General Systems Theory are well aware that to be effective, goals and objectives have to be established top down and not merely aggregated from numerous subsystems. Theater unique principles exist in this fashion, with few universal or system principles.

Another part of the problem deals with equipment technology. There is still equipment in the Army inventory from the Army Area Communications System, and its successor, the Integrated Tactical Communications System. The networking of these older generation systems creates some problems. Newer systems continue to be a part of the same problems. For example, the tactical, ruggedized equipment under procurement as the Tri-Service Tactical Communications family of equipment has numerous difficulties. These difficulties range through incompatibilities, high costs, outdated technologies, insufficient throughput capacities to name a few. Other possibilities to obtain equipment include: buying commercial equipment and adapting it to a mobile military environment; using

requirements are far less than the Army and Air Force. The Marines would typically use the long-haul systems in existence and become a user of Army and/or Air Force theater-wide systems to a limited degree.

- The work effort of the Navy is rather unique. The Navy is not a large user of theater-wide communications systems. Rather, Naval Communication Stations ashore could be used to assist in establishing a more robust, theater system if the equipment and manpower could be made available.
- The work effort of the Defense Communications Agency (DCA) is reviewed for their efforts in Europe, Southwest Asia and the Pacific for an approach to the Joint Multichannel Trunking and Switching system in which all the Military Departments would use a joint system. This system would only officially exist in wartime. Details are contained in an October 1982 paper by this author entitled "The Joint Multichannel Trunking and Switching System (JMTSS): A Survivable and Endurable Theater-Wide Communications System for Use in a Wartime Situation." Discussions have been held with personnel at DCA to include the Director and Deputy Director for Communications Architectures and key staff members who are participating in the JMTSS work effort. Similarly, discussions have also proceeded with personnel who work in support of the effort at the MITRE Corporation, the BDM Corporation and Booz-Allen and Hamilton, Inc.
- Advantage of the personal experience of the author with all Post, Telegraph and Telephone (PTT) organizations and their

equipment procured from allies; and even starting new programs within the Defense Department. Each of these ideas has its own set of difficulties and none are easily overcome. It seems then that a part of the problem is "where do we go from here in choosing the proper equipment technology?"

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- o Similar to the PTT capabilities, an addressal has been made of the use of allied communications systems and those of the North Atlantic Treaty Organization.[4] This data is also highly important in the outcome of this project.
- o Although other material is used as well in the analysis and synthesis of the data in this project, the only remaining one which should be highlighted is the data in a course presented by the Professional Development Center of the Armed Forces Communications and Electronics Association. The course is entitled Command, Control, Communications and Intelligence. A very brief but informative part of this course was presented at the US Army War College during academic year 1984 by Dr. Stuart H. Starr.[5]

ORGANIZATION OF THE PAPER

Chapter II reflects historical approaches to theater communications. It includes command, control and communications aspects, forerunner type systems and lessons learned during these times. The attention given to site location and protection, the use of mobile and fixed plant communications and the establishment of the long-haul Defense Communications System are other aspects. The objective of Chapter II is to show what

communications architecture/system design for the Commander-in-Chief Europe (CINCEUR), the Commander-in-Chief-Readiness Command (CINCRED) and the Commander-in-Chief Pacific (CINCPAC). Note that the scenario for CINCRED is actually the Southwest Asia theater which passes to the Commander-in-Chief Central Command (CINCCENT) since the conversion of the Rapid Deployment Joint Task Force (RDJTF) to the Central Command (CENTCOM).

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Chapter VI presents these conclusions and recommendations after first summarizing the analysis of the study methods which were employed. It is necessary in any study to know the established baseline and algorithm of thought before seizing on the conclusions and recommendations.

Subsequently, one finds in 1980 the publication of a document entitled "Echelons Above Corps Study Report" which continues the later part of the Army work effort.[3] Another study is from the US Army Communications Command known by the short title COMSREAC 85, published in 1979. The full title is "Communications Requirements, Sized Systems and Supporting Force Structure, and Logistical Support Requirements of Echelons Above Corps in 1985." These studies constitute the general flow in the Army work effort, although other documents have been reviewed, and the results of this research paper later include follow on thoughts from this effort. Although the Army has just recently recognized the need for echelons above corps, such as the Theater Army Command, there currently is not a doctrine approved to permit operations and support in the theater if more than a corps is involved.

- The Air Force is equipping Combat Communications Groups with communications equipment. However, the Air Force is not developing an integrated, theater- wide system but rather a system which serves Air Force requirements without much equipment and siting that would provide a high degree of capability towards a survivable and endurable joint system.
- The work of the Marines is a different story from the Army and Air Force. Their systems are low capacity in comparison since they travel light with few circuit requirements needed to accomplish the mission. A Marine Air Ground Task Force generally turns its established beachhead over to the Army and moves on to another mission rather than remain in the same place for a protracted period. If they do remain, their circuit

CHAPTER I

ENDNOTES

1. US Army Combat Developments Command, Institute of Combined Arms, Echelons Above Division, p. 1.

2. John L. Romjune, A History of Army 86, Vol. II, p. 90.

3. US Army Combined Arms Combat Development Activity, Echelons Above Corps Study Report.

4. The author of this individual study project worked in the North Atlantic Treaty Organization Integrated Communications System Management Agency (NICSMA) from 1974 through 1982. He has also published on the NATO Integrated Communications System (NICS) in Paris and Washington.

5. Dr. Stuart H. Starr, Echelons Above Corps/Corps Command and Control, Lecture, 30 November 1983.

CHAPTER II

HISTORICAL APPROACHES

One should always be mindful of the history of whatever current or future area of study is being addressed. Lessons learned usually have value for many years or generations until negated by a major change in

respective government ministries in the North Atlantic Treaty Organization, several PTTs in the Pacific and Southeast Asia, telephone systems within the United States, and some studies of capabilities of PTTs in other countries, particularly, Southwest Asia. This data is highly important in the outcome of this project.

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has been done in the past and thereby depict the baseline systems one must work with today in trying to achieve an effective theater communications system.

Chapter III portrays some general aspects of both an Army only communications system within the theater and an integrated, theater-wide system with joint Military Department participation. Next the principles of each of these two different approaches are examined. The objective of such a detailed analysis is to point out the advantages and disadvantages of each approach. The Army could decide whether to continue on with its own system as in the echelons above corps or consider part participation or full participation in a joint system. The analysis is not conducted by theater, since the application at theater level lies in Chapter IV.

Chapter IV first addresses topics which are common or similar in the three theaters of Western Europe, Southwest Asia and the Pacific. Maps are included for geographical bounding. Then, theater unique principles are addressed for the individual theaters. Chapter V brings together the evolution of Chapters III and IV.

Chapter V delves into the one or more possible Army roles which appear viable for theater communications within each theater. A final solution cannot result from such a limited study, but directions of interest do materialize for continuing possibilities. Only through a well developed overall communications architecture, tempered with valid requirements and availability of resources, can a more specific path be chosen. Conclusions and recommendations can be drawn from this study project which are helpful in assessing where the Army has been, finds itself now and could possibly proceed towards implementation and installation of a viable system.

intermediate switching centers exist in other European countries, all of which also have associated telephone exchanges. Manual switchboards are located throughout the DDD Network and are interconnected with ringdown trunks. Most of the telephone exchanges, or PABXs, are interconnected to one or more other PABXs over telephone channels and each PABX can automatically transmit telephone numbers to the other without operator intervention. Most of the equipment in the DDD Network is at least 30 years old. The manufacture of this equipment has long been discontinued and spare parts have long been difficult to obtain. The point in describing the DDD is to reflect the interconnection of many PABXs and manual switchboards in this largest subsystem of the overall voice system in this theater. These switchboards and PABXs electrically function on a 2 wire basis. Transmission facilities other than local land cables provide an electrical 4 wire path. Accordingly, many of the calls in the DDD Network are converted many times as a call is connected. Figure II-1 is essentially the USAREUR DDD Network with a small number of other telephone exchanges known as the USAFE VF Dial Network. The purpose of the figure is to show pictorially, without necessarily the intention of clarity, the vastness of the network.

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Defense Communications System (DCS)

The DCS was established in the early 1960s and included the long-haul circuits between theaters, between the United States and locations

Chapter VI presents these conclusions and recommendations after first summarizing the analysis of the study methods which were employed. It is necessary in any study to know the established baseline and algorithm of thought before seizing on the conclusions and recommendations.

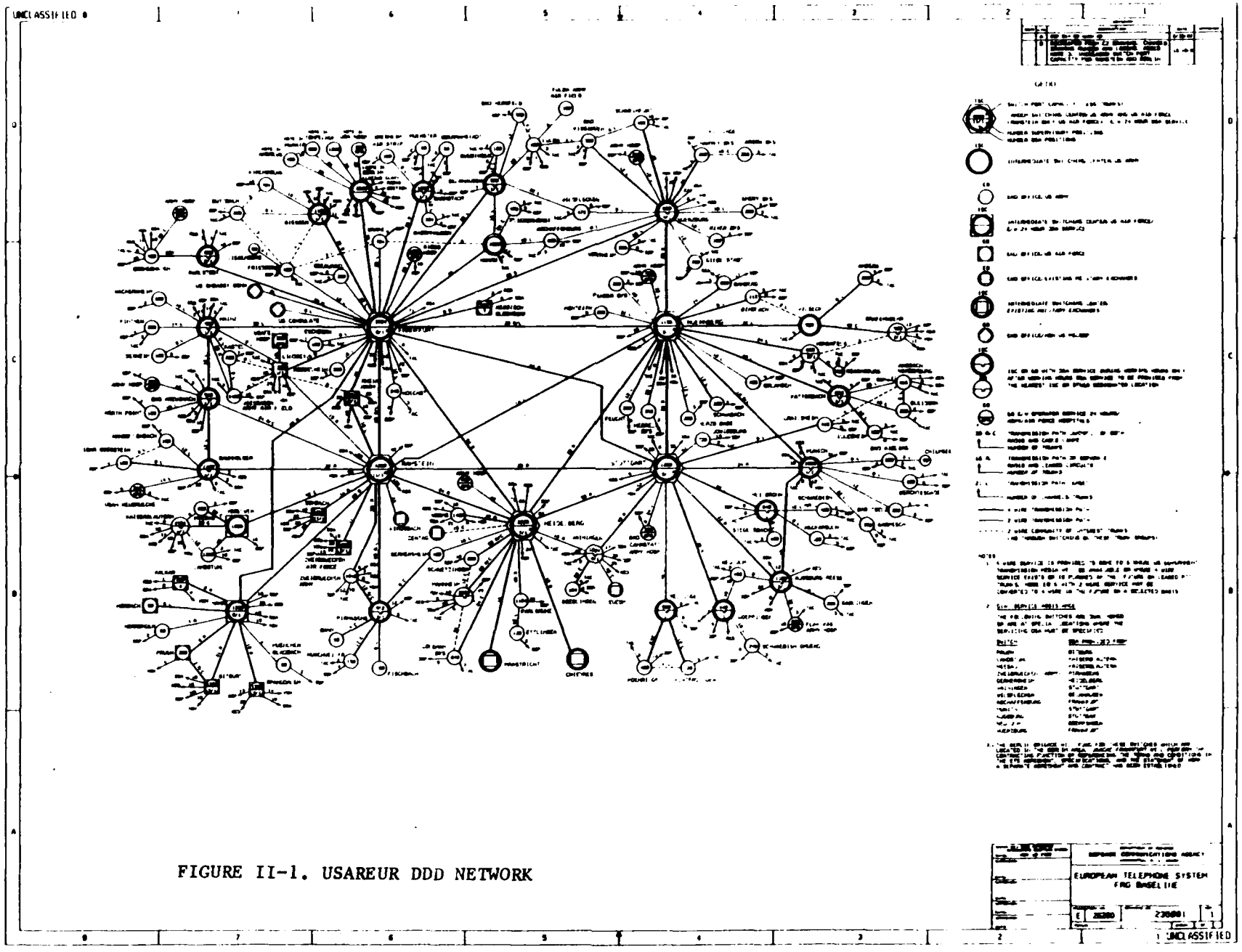

FIGURE II-1. USAREUR DDD NETWORK

CHAPTER I

ENDNOTES

1. US Army Combat Developments Command, Institute of Combined Arms, Echelons Above Division, p. 1.

2. John L. Romjune, A History of Army 86, Vol. II, p. 90.

3. US Army Combined Arms Combat Development Activity, Echelons Above Corps Study Report.

4. The author of this individual study project worked in the North Atlantic Treaty Organization Integrated Communications System Management Agency (NICSMA) from 1974 through 1982. He has also published on the NATO Integrated Communications System (NICS) in Paris and Washington.

5. Dr. Stuart H. Starr, Echelons Above Corps/Corps Command and Control, Lecture, 30 November 1983.

out of the United States, between countries and sometimes within countries. The Defense Communications Agency (DCA) would have network management responsibility and the MILDEPs would have operational and maintenance responsibility. Members of all the services would staff DCA.

Three programs were established for the DCS to improve the quality of long-haul systems and were titled the Automatic Voice Network (AUTOVON), Automatic Secure Voice Network (AUTOSEVOCOM) and the Automatic Digital Network (AUTODIN). Transmission systems by satellite, underseas cable, high frequency radio and commercial, leased circuits constituted the bulk of the effort to provide and improve the interconnects of switching facilities.

The AUTOVON was designated the principal command and control, long-haul, common user, voice switching system. It also provided for connection of other types of special purpose networks on either a primary basis or as backup. Implementation began in the late 1960s and operations commenced in 1969-1970 for the European theater. Eventually 10 switching centers were cutover for service. Thus for the first time a theater switching system received greatly enhanced service by the implementation of a common user, long-haul system. Direct lines to individual PABXs from out-of-theater were essentially eliminated. The AUTOVON permitted common user traffic to flow over any available path and then be switched automatically within the theater to the destination PABX.

The AUTOSEVOCOM was designated to provide and improve secure voice service. Service was to be by narrowband and wideband paths. Eight backbone locations were identified in the European theater for implementation.

CHAPTER II

HISTORICAL APPROACHES

One should always be mindful of the history of whatever current or future area of study is being addressed. Lessons learned usually have value for many years or generations until negated by a major change in operational concept or perhaps by a major technological advance. Accordingly, this chapter unfolds the historical approaches to communications, primarily theater or operational level, in the Western European, Pacific and Southwest Asia theaters. These approaches lead to a baseline understanding which has to be built upon, not ignored, as a transition is made towards communications systems that must provide capabilities to fulfill requirements. The discussions follow by theater. Some details are not included so that the paper can remain unclassified and so as not to distract the reader.

EUROPEAN THEATER

The discussion of this theater might best begin during the World War II era. During World War II the communications systems consisted of what could be carried to the battle, what military systems already existed in place and what commercial systems could be utilized. In the post war period most of the United States forces in Germany located on Kasernes which had previously been locations for German forces. Many of these locations had communications facilities in place and were used as an initial capability. The switching equipment for theater-wide

The AUTODIN was designated to provide and improve service between data subscribers by the use of store and forward message switches. The AUTODIN switches were implemented with computer controlled capabilities, and various data rates were possible between the switches and the users and other switches.

In summary the establishment of the DCS with its programs provided a major enhancement to the baseline of the theater communications. Long-haul service was automated and common user oriented. Due to many special features such as direct dial to an in-theater user, different precedence level handling of calls and automatic testing of equipment, a greatly improved grade of service was achieved. The workload was reduced on in-theater switchboard operators as well. Since the switches within AUTOVON, AUTOSEVOCOM and AUTODIN all functioned on a 4 wire basis, high quality connections were established.

Consoles

Various types of consoles were also introduced in dedicated voice systems. An example is consoles which interconnected long-haul paths to command and control users. Various types were provided either according to the level of users involved, the quantity of users who required connectivity or the types of features which were required. As the AUTOVON became available, many of the long-haul paths in dedicated networks were integrated into AUTOVON while others remained on a dedicated basis for redundancy.

European Telephone System (ETS)

In 1970 a concept began to mature for an upgrade of the theater-wide communications systems. Each MILDEP tended to concentrate on aspects of these upgrades which primarily affected their own operations. The

communications in all countries consisted of manual switchboards and private automatic branch exchanges (PABXs).

Over the following years there were equipment expansions, equipment upgrades and the introduction of additional capabilities. Some of the capabilities served in the role of common user systems (i.e., available for general usage) and some of the capabilities served in the role of dedicated systems (i.e., available only to specialized users). The common user systems continued to evolve, and the principal voice communications systems became known as the following: US Army Europe (USAREUR) Direct Distance Dial (DDD) Network, USAREUR Dial Service Assistance (DSA) Network, US Air Force Europe (USAFE) Voice Frequency (VF) Dial Network, and in the United Kingdom the US Forces Administrative Telephone Network. Dedicated networks consisted of capabilities for a large number of very small similar networks for very specialized communities of interest. Since the focus of this study is theater-wide communications, communications capabilities of corps and below will not be addressed. The transmission systems evolved through landlines, high frequency radio, line-of-sight radio and eventually other types of radio such as ionospheric scatter and tropospheric scatter. Now that the general baseline has been established, major enhancements to this baseline can update changes from the 1960s to the early 1980s.

Direct Distance Dial Network

The original USAREUR DDD Network still basically exists today although its equipment is starting to be upgraded and will later be merged with other systems. In Germany alone it consists of five higher level tandem switching centers, 12 mid level or intermediate switching centers and approximately 122 telephone exchanges. Approximately 17

concept further matured into an overall system view for the theater. In early 1973 a subsystem project/plan was completed at the Defense Communications Agency and staffed through the office of the Joint Chiefs of Staff.[1] This plan addressed the inclusion of the USAREUR DDD Network, the USAREUR DSA Network, the USAFE VF Dial Network and the US Forces Administrative Telephone Network into a common user, theater-wide network. All tandem switching centers and PABXs would be replaced with modern equipment and capabilities with few exceptions. The ETS would also interface the AUTOVON. Later influencing factors, such as user requirements, equipment technology and theater-wide objectives expanded the scope of the ETS to include AUTOVON service and permit the elimination of the older AUTOVON switches. Thus the ETS would carry not just administrative traffic but operational command and control, secure voice and data traffic as well. In 1978 assignments were made to the US Army and US Air Force for procurement and implementation of ETS sites. Initial operational capability is now being achieved at several of the sites. Final operational capability is not anticipated at all sites until about 1995.

Summary

The objective in this discussion of historical approaches to communications in the European theater was to permit a long term view of the past. The reader can see the initial capability as a series of "connect together whatever we have." The next step was to start upgrading and expanding what was in place in the theater. New equipment was also introduced. Then, a significant concentration on improvement of the long-haul capability emerged. Since the theater was distant from the National Command Authorities and CONUS based support services, this

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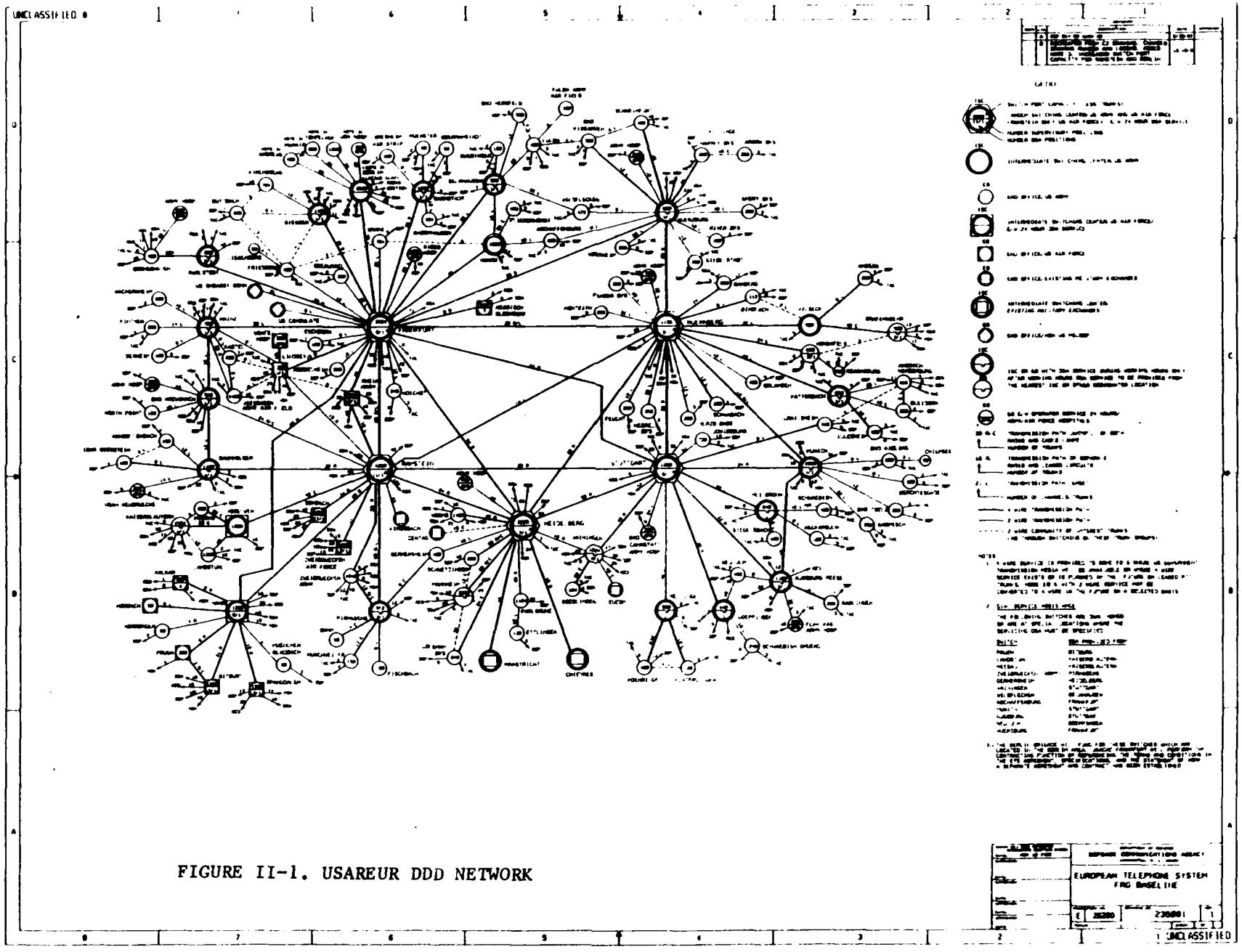
long-haul improvement was necessary for command and control and support. The next step was to plan the replacement of the in-theater facilities, which were greatly outdated and expensive to support. Slowly the small dedicated networks evolved into larger common user systems for better service with less communications paths. Manual and low capacity networks evolved into automatic, high capacity, multichannel networks. This summarizes the current baseline and that projected into the near future. While redundancy is there through alternate routing, little has been said about deficiencies which must be overcome if the theater communications are to be survivable and endurable. Aspects such as hardened facilities, mobile/transportable equipment and reconstitution of sites will be addressed later in an assessment of each theater in Chapter IV.

SOUTHWEST ASIA THEATER

Since there has not been an establishment of communications capabilities in this theater, an historical discussion is not necessary.

PACIFIC THEATER

During the Korean war the communications systems consisted of what could be carried to the battle, what military systems already existed in place and what commercial systems could be utilized. The locations essentially include Hawaii, Japan including Okinawa, Republic of Korea, Guam, Aleutians, Philippines, Taiwan, and recently, Diego Garcia. A separate presentation will also be given on what was known as the Southeast Asia Tandem Switching System. Although this region cannot be



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To illustrate the typical intra-country areas of communications interest, several figures are presented as examples. Figure II-2 is a depiction of the connectivity in Guam. Figure II-3 is a depiction of the connectivity in the Philippines. The areas of interest are valid even though the existing transmission facilities reflect some proposed upgrades. Figure II-4 is a depiction of the connectivity in Japan including AUTOVON and tandem switches. The areas of interest are valid even though some upgrades are included. Figure II-5 is a depiction of the current connectivity for the in-theater and out-of-theater paths in the AUTOVON. Similar to the project for the European Telephone System

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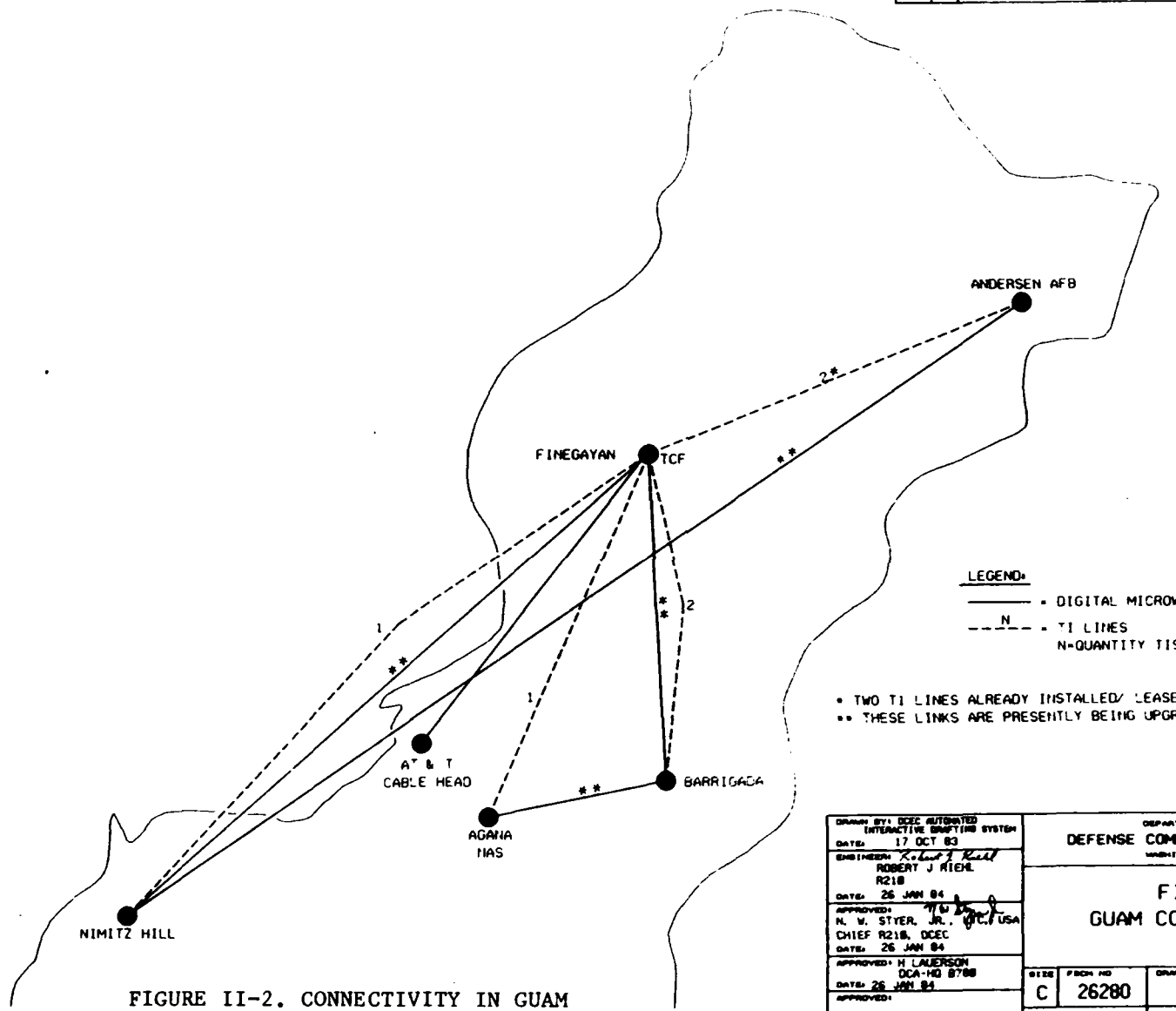

FIGURE II-2. CONNECTIVITY IN GUAM

DEPARTMENT OF DEFENSE
DEFENSE COMMUNICATIONS AGENCY
WASHINGTON, D. C. 20305

FIGURE 2
GUAM CONNECTIVITY

SIZE	FSCM NO	DRAWING NO	VER
C	26280	235043	1

SCALE: SHEET OF

DRAWN BY: DCEC AUTOMATED INTERACTIVE DRAFTING SYSTEM
DATE: 17 OCT 83
ENGINEER: ROBERT J RIEHL R218 DATE: 26 JAN 84
APPROVED: N. W. STYER, JR., LTC, USA CHIEF R218, DCEC DATE: 26 JAN 84
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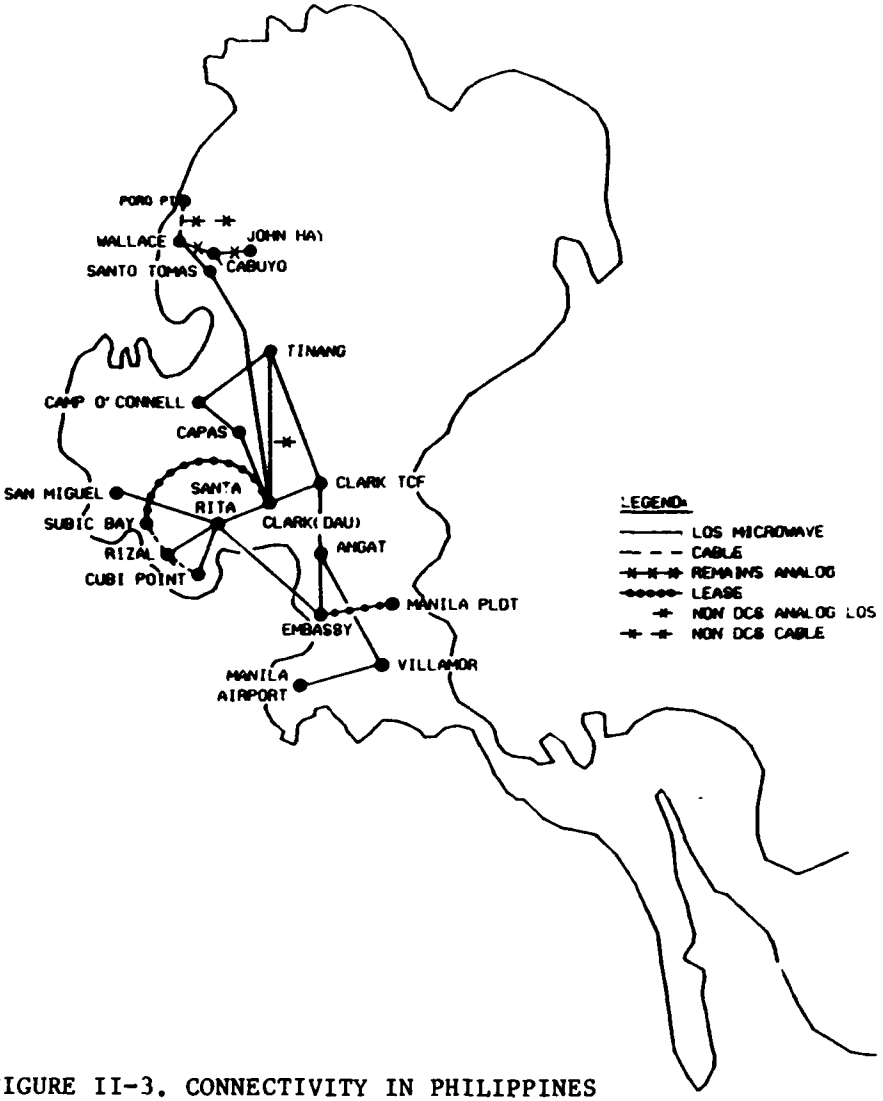

FIGURE II-3. CONNECTIVITY IN PHILIPPINES

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DRAWN BY: DISC GENERATED INTERACTIVE DRAFTING SYSTEM
DATE: 6 DEC 83
ENGINEER: ROBERT J RIEHL R21B 2 DEC 83
APPROVED: H.W. STYER, JR, LTC(P) USA CHIEF R21B DCEC
DATE: 2 DEC 83
APPROVED: H LOVERDON HQS DCA 6788
DATE: 2 DEC 83
APPROVED:
DATE:

DEPARTMENT OF DEFENSE
DEFENSE COMMUNICATIONS AGENCY
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FIGURE 2
PROPOSED NETWORK CONFIGURATION OF THE DCS IN THE PHILIPPINES

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long-haul improvement was necessary for command and control and support. The next step was to plan the replacement of the in-theater facilities, which were greatly outdated and expensive to support. Slowly the small dedicated networks evolved into larger common user systems for better service with less communications paths. Manual and low capacity networks evolved into automatic, high capacity, multichannel networks. This summarizes the current baseline and that projected into the near future. While redundancy is there through alternate routing, little has been said about deficiencies which must be overcome if the theater communications are to be survivable and endurable. Aspects such as hardened facilities, mobile/transportable equipment and reconstitution of sites will be addressed later in an assessment of each theater in Chapter IV.

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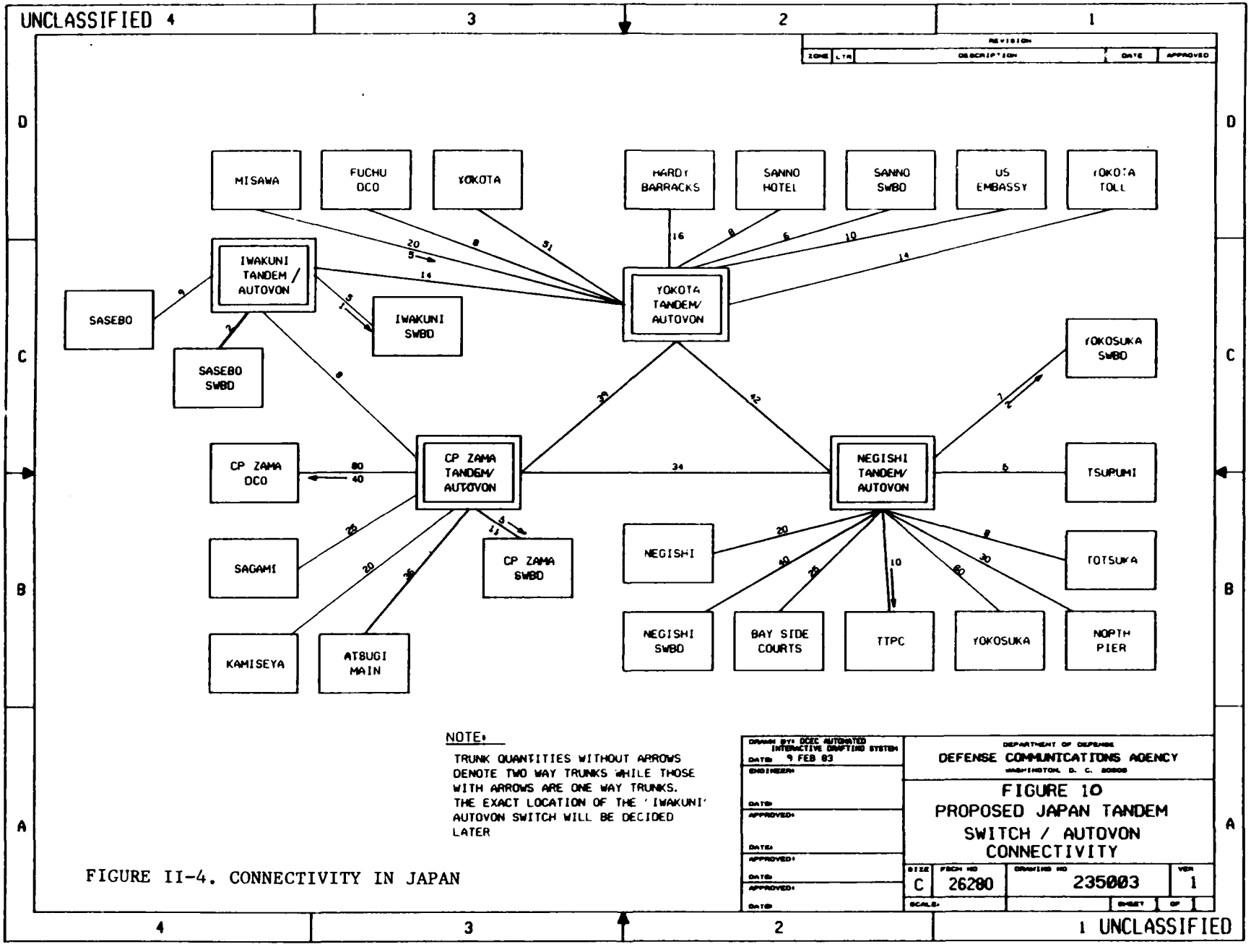

FIGURE II-4. CONNECTIVITY IN JAPAN

included in the Pacific theater, the lessons learned there on the establishment of a joint multichannel switching system are extremely important in current and future endeavors in theater communications. An overall in-depth discussion is not necessary since much of the evolution in theater communications is similar to the European theater and need not be repeated. The essential differences for this theater need only be specified.

Intra-Country Networks

The intra-country networks evolved much as in the European theater. In some countries after World War II and certainly in the post Korean war period, some military facilities made use of surviving equipment, and others, as in much of Korea, had to be established anew. Similar to the European theater, most facilities were on a 2 wire basis for switching equipment with the necessary 4 wire and 2 wire conversions for transiting 4 wire transmission equipment. The intra-country networks also evolved independently from other countries because of the vast geographic separation. Dedicated networks and common user networks evolved but on a much smaller scale than in Germany. Traffic volume was, accordingly, much less as well because of the smaller size of troop concentrations and the smaller geographic area.

Probably the most significant intra-country development other than equipment upgrades was the establishment of a 4 wire switching capability in Japan during the early 1970s known as the Kanto Plains Switching System.

Inter-Country Networks

Originally the long-haul connectivity among the countries in the Pacific theater and to the United States was as in the European theater

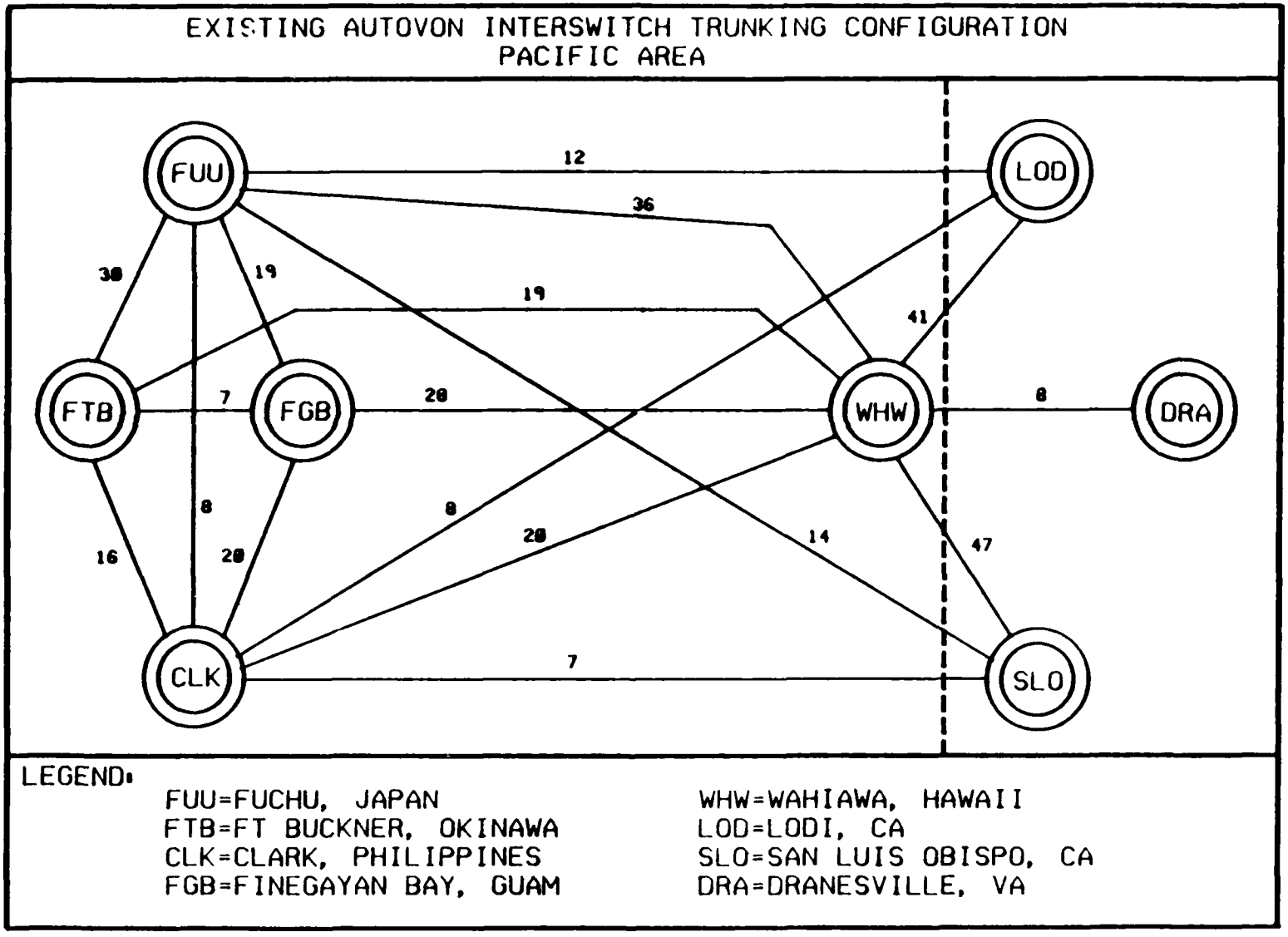

FIGURE II-5. PACIFIC THEATER AUTOVON CONNECTIVITY

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in the European theater, Figure II-6 is a depiction of the current approach for the interconnection of principal switching centers in-theater and out-of-theater for the Pacific theater. Now it is very appropriate to look at the first theater-wide, joint communications system with automatic switching. This system is the forerunner, although on a smaller scale, of the concept behind the European Telephone System. The lessons learned are important and an important part of the historical approaches in theater communications.

Southeast Asia Tandem Switching System (SEATSS)

This system consisted of nine Tandem Switching Centers (TSCs) within the Southeast Asia Mainland. Table II-1 lists them including location and the MILDEP responsible for operations and maintenance. The TSCs were cutover for service from December 1968 through December 1969.[2] Their function was to provide automatic switching of telephone traffic within the Southeast Asia Mainland. The telephone traffic concerned approximately 48 telephone exchanges, and interconnectivity of two of the TSCs with the AUTOVON. The connectivity between the TSCs ensured alternate routing of telephone calls if paths were busy or out of service. The TSCs also switched the telephone calls on a 4 wire basis.

The SEATSS in conjunction with the telephone exchanges was entitled the Southeast Asia Automatic Telephone System (SEA-ATS). The US Army and the US Air Force operated the TSCs in this theater-wide, long distance telephone system thereby establishing the first modern "joint" system. All MILDEPs, State Department and joint elements in the theater received telephone service through the SEA-ATS. It has been necessary

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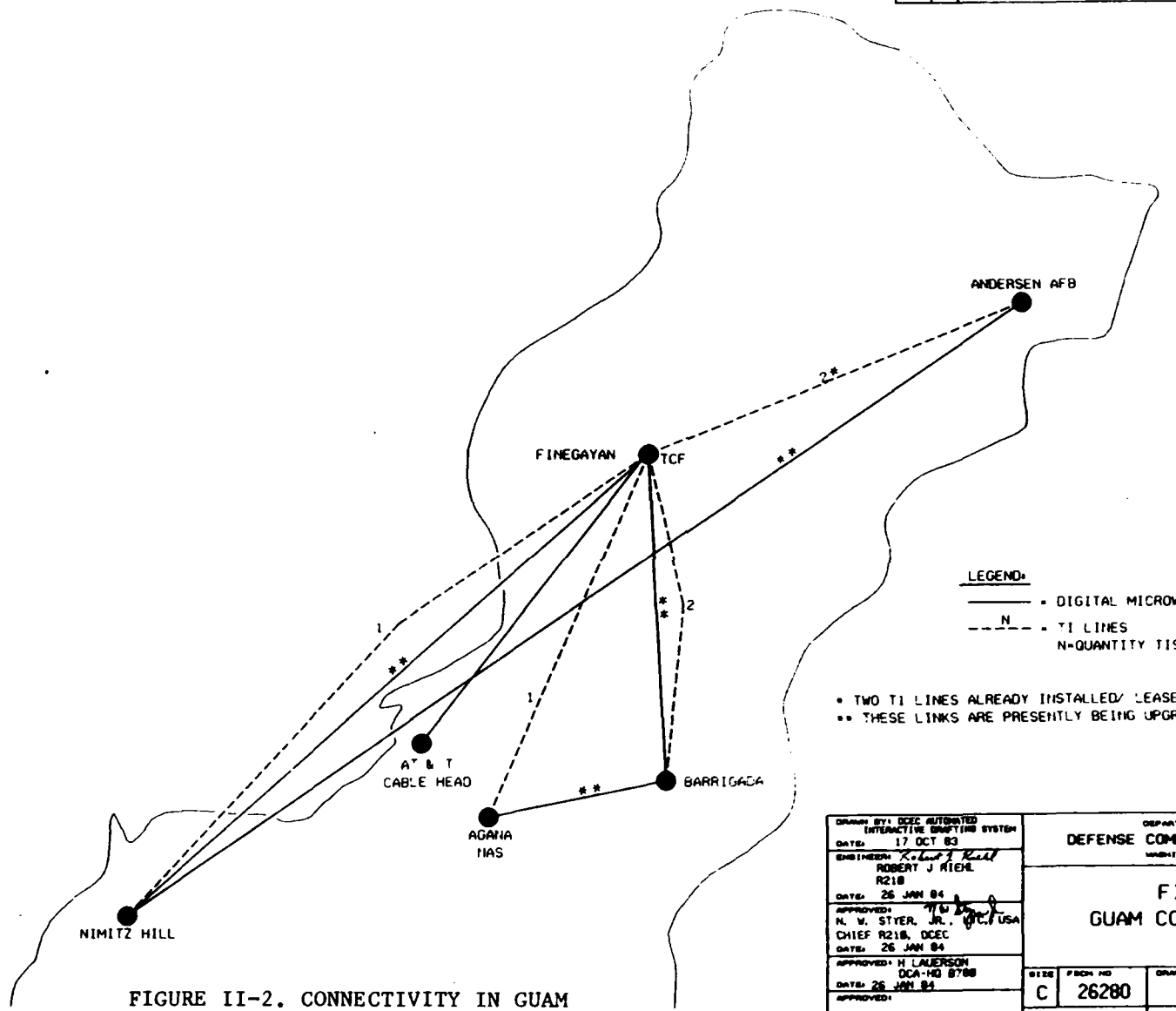

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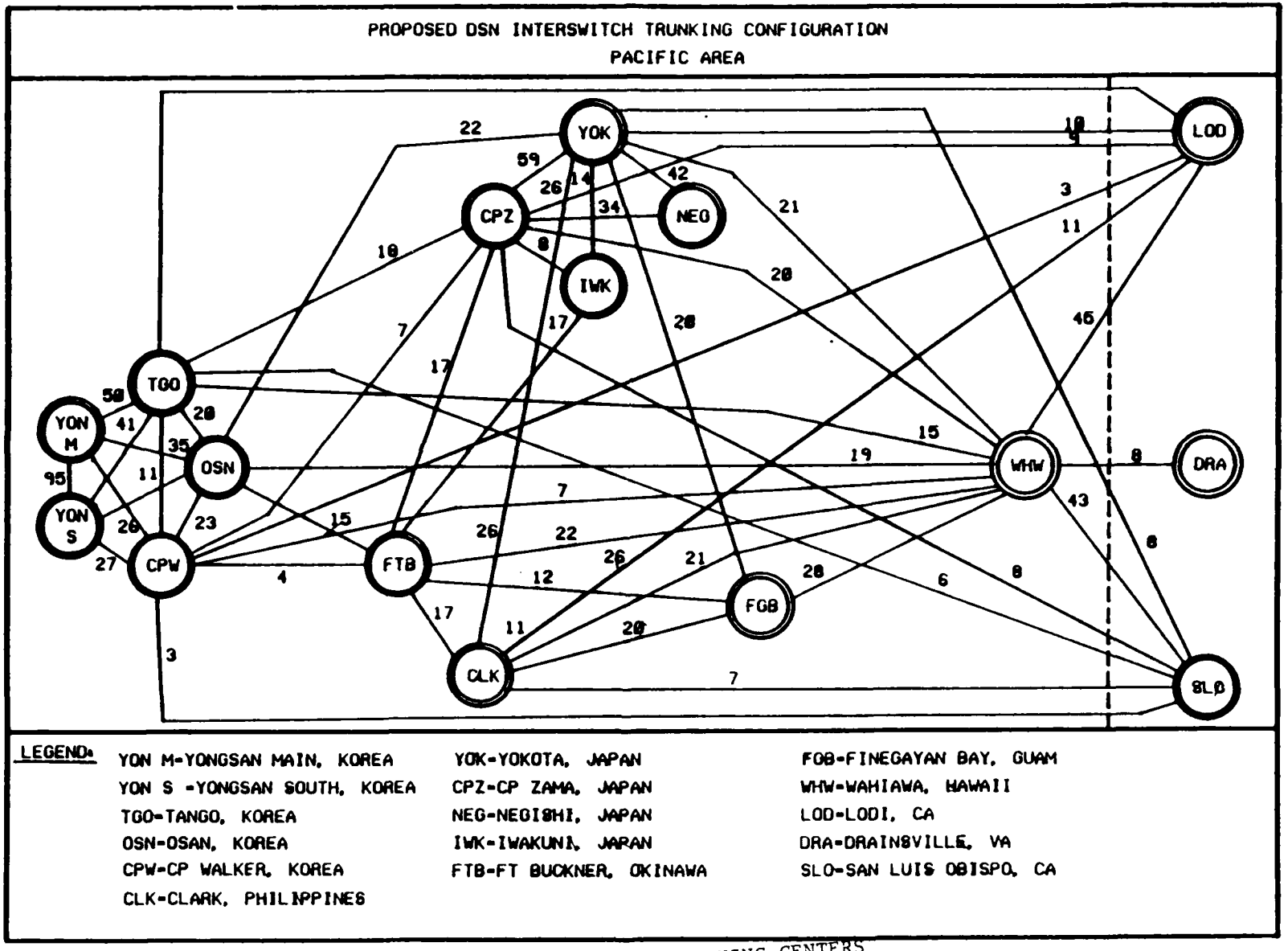
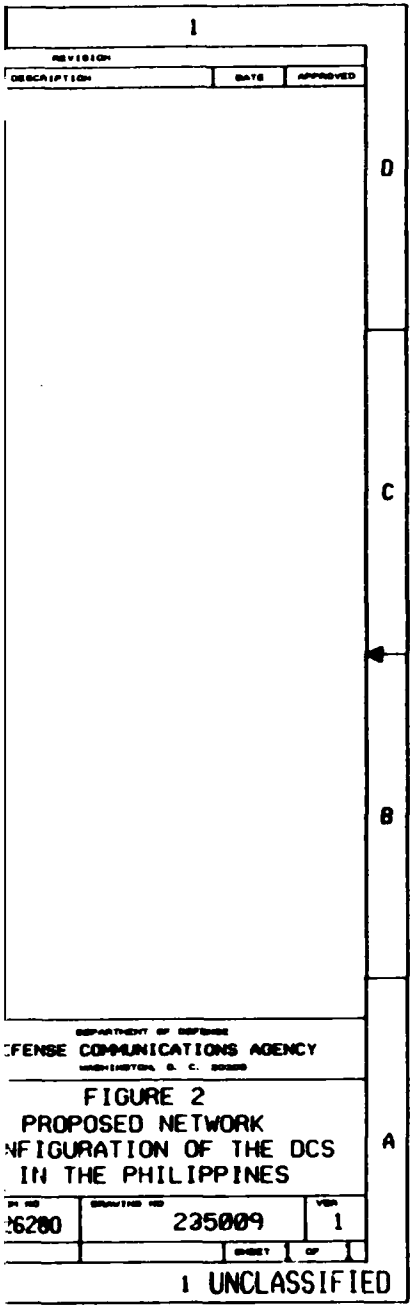


FIGURE II-6. PACIFIC THEATER PRINCIPAL SWITCHING CENTERS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REVISION
DESCRIPTION
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DEFENSE COMMUNICATIONS AGENCY
WASHINGTON, D. C. 20305
FIGURE 2
PROPOSED NETWORK
CONFIGURATION OF THE DCS
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to include this system in the historical approaches so that the experience from it can be used in assessing possible future Army roles in theater-wide communications.

Summary

The objective in this discussion of historical approaches to communications in the Pacific theater was to reflect the differences from the long term view of the past in the European theater. The reader can see the great similarity with only several exceptions:

- o Traffic volume was less.
- o 4 wire switching system was introduced in Japan.
- o 4 wire JOSSs were used on a manual basis before AUTOVON to ensure better quality paths over the long distances for transmission facilities.
- o The SEATSS was established as the first, theater wide, joint switching system.

The possible Army roles in the Pacific theater will be addressed in Chapter V after viewing the current state of this theater in Chapter IV. Chapter IV includes an addressal of deficiencies which must be overcome if the theater communications are to be survivable and endurable.

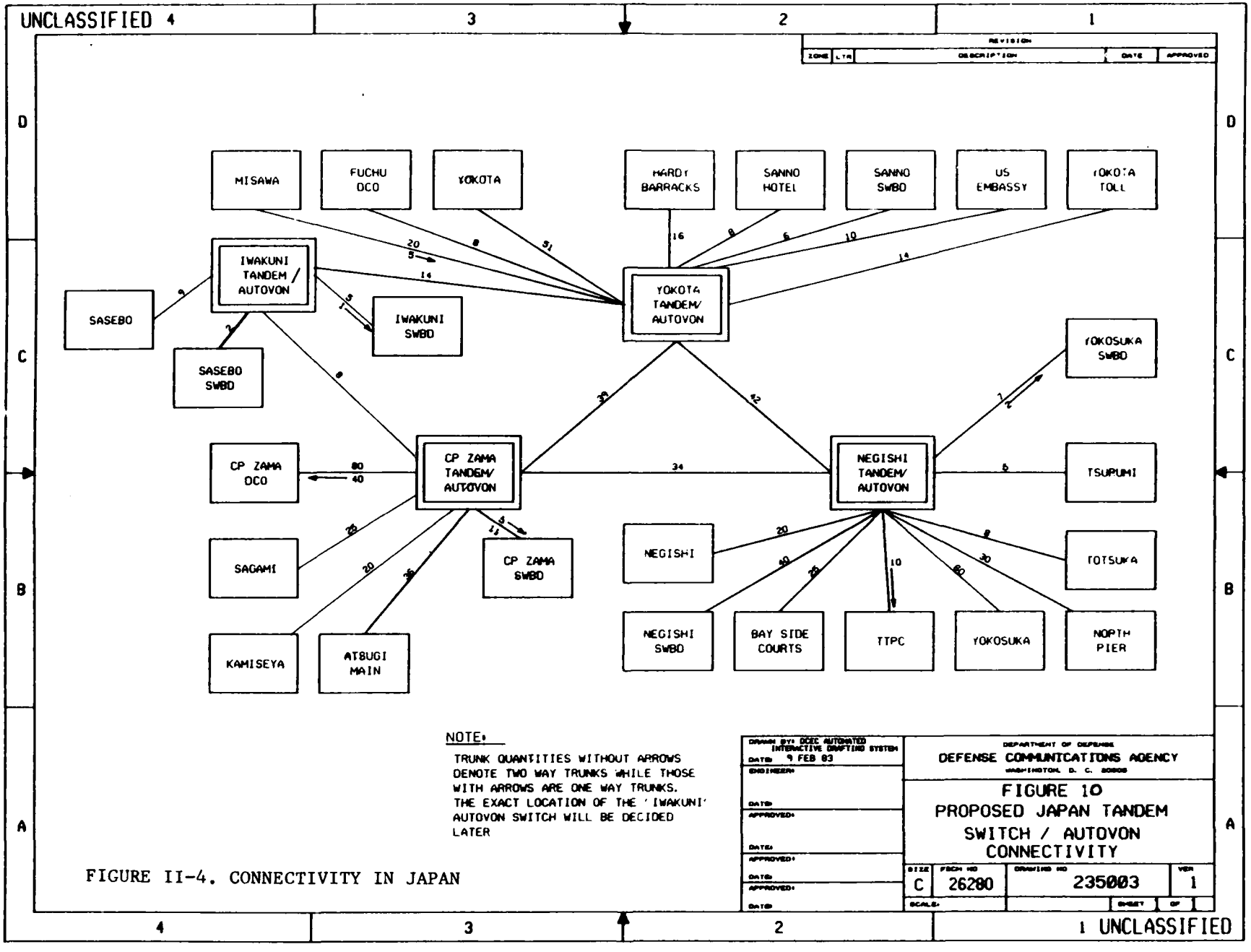

FIGURE II-4. CONNECTIVITY IN JAPAN

CHAPTER III

THEATER-WIDE COMMUNICATIONS SYSTEM

This chapter focuses on the communications and electronics capabilities in a theater-wide system from two alternatives. The first alternative is the desire of the Army to ensure better command and control of its forces with the Army component commander having operational control of the resources. Interfaces would be effected where necessary. The second alternative is to examine an integrated and joint theater-wide system with other MILDEPs, primarily the Air Force, in which operational control would not be totally the purview of a single component in the theater. Interfaces would be fewer in an integrated system, and the treatment of joint operations and combined operations would differ in operation and support of the theater-wide communications system.

These theater-wide communications are the key to effective command and control. If communications is a weak link, then superiority in the C^2I functions would still have little effect. It is better to have communications capabilities which can support fair C^2I capabilities than to have superior C^2I capabilities without communications.

Figure III-1 is a pictorial depiction of previous discussions on the communications within the theater. The Defense Communications System brings the long-haul connectivity into the theater. The theater-wide communications system ensures a survivable and endurable capability among the theater commander, component commanders, joint elements and any designated elements such as logistics, personnel and support centers

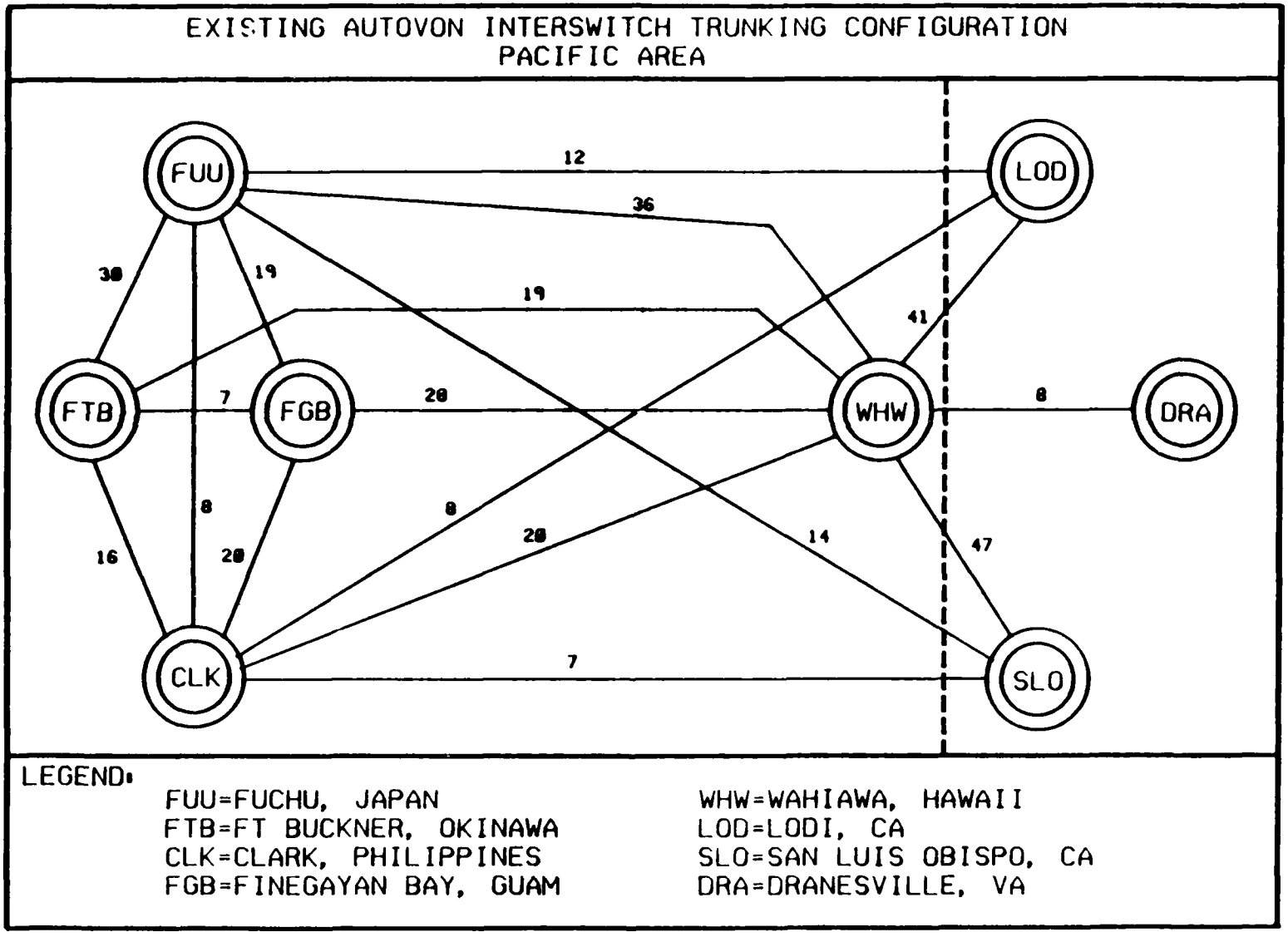

FIGURE II-5. PACIFIC THEATER AUTOVON CONNECTIVITY

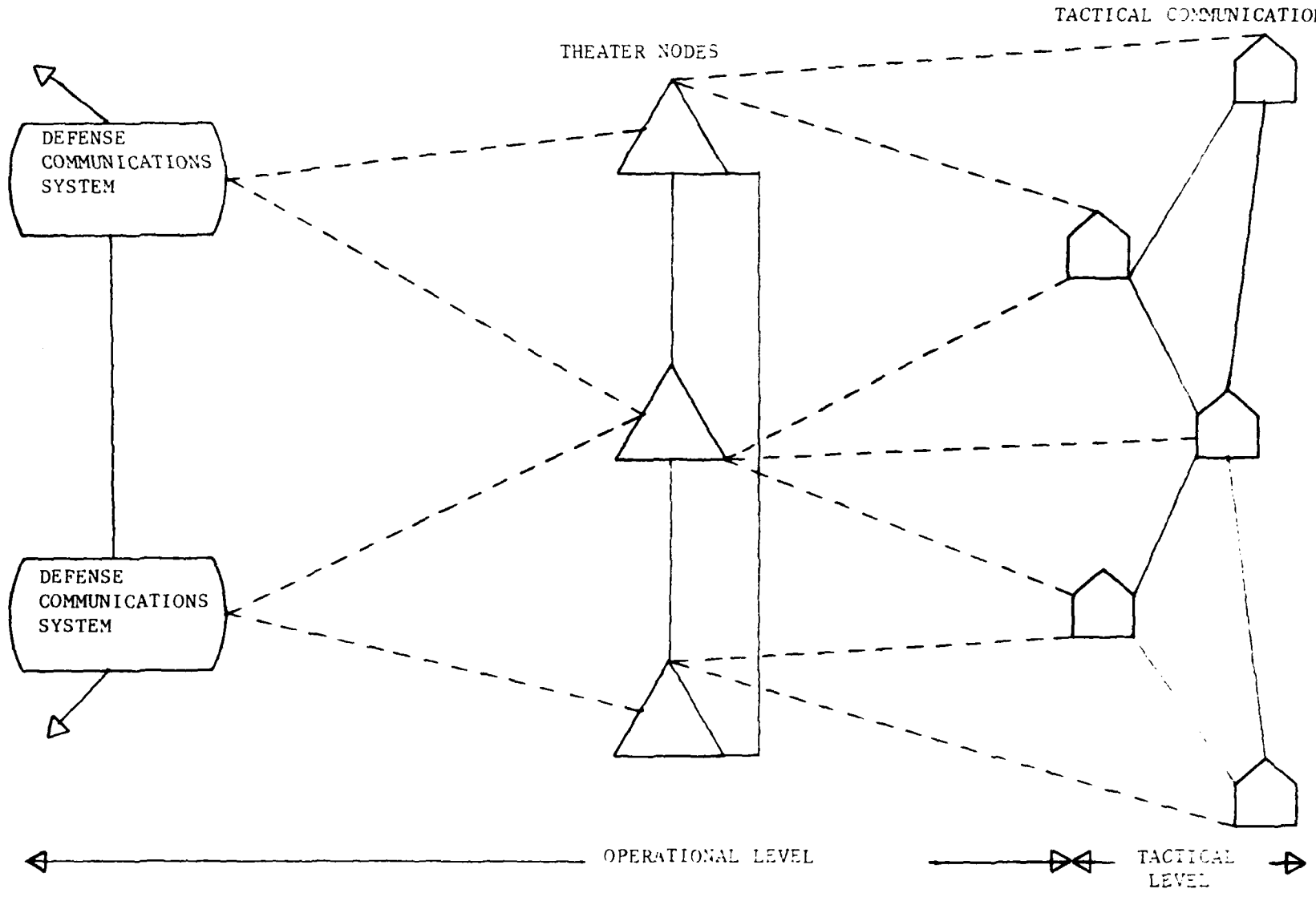

FIGURE III-1. THEATER COMMUNICATIONS

in the European theater, Figure II-6 is a depiction of the current approach for the interconnection of principal switching centers in-theater and out-of-theater for the Pacific theater. Now it is very appropriate to look at the first theater-wide, joint communications system with automatic switching. This system is the forerunner, although on a smaller scale, of the concept behind the European Telephone System. The lessons learned are important and an important part of the historical approaches in theater communications.

Southeast Asia Tandem Switching System (SEATSS)

This system consisted of nine Tandem Switching Centers (TSCs) within the Southeast Asia Mainland. Table II-1 lists them including location and the MILDEP responsible for operations and maintenance. The TSCs were cutover for service from December 1968 through December 1969.[2] Their function was to provide automatic switching of telephone traffic within the Southeast Asia Mainland. The telephone traffic concerned approximately 48 telephone exchanges, and interconnectivity of two of the TSCs with the AUTOVON. The connectivity between the TSCs ensured alternate routing of telephone calls if paths were busy or out of service. The TSCs also switched the telephone calls on a 4 wire basis.

The SEATSS in conjunction with the telephone exchanges was entitled the Southeast Asia Automatic Telephone System (SEA-ATS). The US Army and the US Air Force operated the TSCs in this theater-wide, long distance telephone system thereby establishing the first modern "joint" system. All MILDEPs, State Department and joint elements in the theater received telephone service through the SEA-ATS. It has been necessary

which may be required. Before developing the two aforementioned alternatives, the following points are common to both.

COMMON POINTS

The following points are actually common to both alternatives, and are listed here to avoid repetition:

- o Someone must be in charge. We can discuss individual component systems which are interfaced or a single, integrated system, but there must be a single manager in either case.
- o In accordance with the theme of Presidential Directives Number 58 and 59 and other guidance, the theater-wide system must be, or have as objectives to be survivable and endurable.
- o There are numerous deficiencies inherited from the past in communications capabilities which must be overcome in addition to addressing survivability and endurability.
- o Resource allocation. Resources have to be matched against alternative and competing needs. Realistically, tradeoffs will probably occur.
- o Either type of theater-wide communications system must be able to support joint operations, combined operations, contingency operations and any Army only operations, especially large unit.

ARMY THEATER COMMUNICATIONS SYSTEM

This alternative focuses upon a maximization of operational control by the Army over Army elements in the provision of C^3I capabilities to support doctrinal and C^3I requirements at the operational level. This study is not intended to result in the final solution so questions such as "how many echelons would be required above corps?" are not treated.

As noted in the Statement of the Problem, a communications system is needed within a theater to permit the CINC to exercise command and control effectively. This alternative is rather a polar extreme of any "joint" system because of the maximization of Army control. The Army is

within the theater rather than interfacing subsystems of the components which have been optimized at the subsystem level.

The biggest advantage would be a more homogeneous system at less cost than the first alternative of an Army theater communications system once the costs of other component systems are included. Homogeneity would apply not only to the equipment but to the procedures, network management and system control as well. The disadvantage would be having to depend on another component "to be there" and function in its role. While the network would have to have a single manager, there is not an established base for procedures, network management and system control of a joint theater-wide system. This alternative must be examined in great detail in an organizational and operational concept to include deployment of forces in varying scenarios. Otherwise, a contingency operation might occur in which a non participating force did not deploy, for example, a much needed switching center, thereby greatly inhibiting the effectiveness of the joint communications system.

Figure III-2 hypothetically illustrates additional fundamental points and advantages which are well worth considering. If the Army and Air Force each have 10 paths between two locations which have automatic switches, the traffic carrying capacity can be determined from standard traffic tables. If a joint switching center were at each location and the entire 20 paths were available, then additional traffic carrying capacity is available over the sum of 2 individual paths of 10 each (i.e., increase of 34 1/2 percent). Alternatively, if it is necessary to reduce the number of paths, then a single group of 16 paths would equal the original traffic carrying capacity with a savings of 4 paths (i.e., 20 percent savings). In addition to increased capacity, improved network management and greater capability for alternate routing of calls would

Site	Location	MILDEP
A	Can Tho, Republic of Viet Nam (RVN)	US Army
B	Tan Son Nhut, RVN	US Air Force
C	Nha Trang, RVN	US Air Force
D	Vung Chua Mountain, RVN	US Army
E	Da Nang, RVN	US Air Force
F	Pleiku, RVN	US Air Force
G	Bang Pla, Thailand	US Army
H	Korat, Thailand	US Air Force
I	Warin, Thailand	US Air Force

TABLE II-1 SOUTHEAST ASIA TANDEM SWITCHING SYSTEM[3]

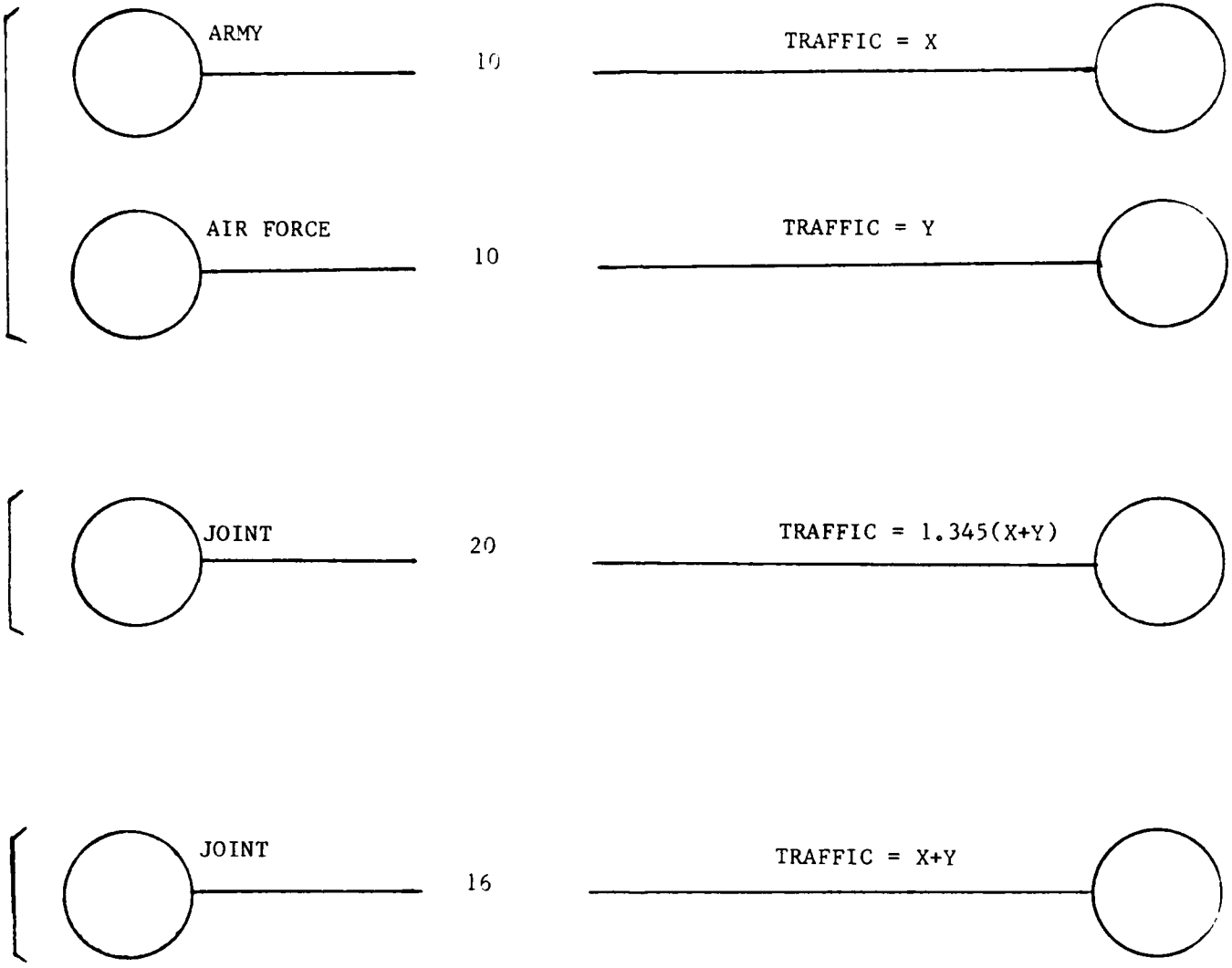

FIGURE III-3. ADDITIONAL BENEFITS OF JOINT THEATER-WIDE OPERATIONS

to include this system in the historical approaches so that the experience from it can be used in assessing possible future Army roles in theater-wide communications.

Summary

The objective in this discussion of historical approaches to communications in the Pacific theater was to reflect the differences from the long term view of the past in the European theater. The reader can see the great similarity with only several exceptions:

- o Traffic volume was less.
- o 4 wire switching system was introduced in Japan.
- o 4 wire JOSSs were used on a manual basis before AUTOVON to ensure better quality paths over the long distances for transmission facilities.
- o The SEATSS was established as the first, theater wide, joint switching system.

The possible Army roles in the Pacific theater will be addressed in Chapter V after viewing the current state of this theater in Chapter IV. Chapter IV includes an addressal of deficiencies which must be overcome if the theater communications are to be survivable and endurable.

result. Also, if a joint switching center is utilized, then smaller user areas, which are homed on the joint switching center, would not have to be compatible with each other in signaling and transmission as long as each were compatible with the joint switching center. In the case of separate Army and Air Force switching centers, they would each have to be compatible with each of their respective user areas and with each other. In other words, some simplification of interfaces occurs with the operation of the joint switching center.

CHAPTER II

ENDNOTES

1. The author of this study authored the European Telephone System Subsystem Project/Plan in early 1973 after gathering considerable inputs from the MILDEPs and coordinating among all who were involved in the planning process.

2. US Army Strategic Communications Command, Technical Acceptance Test of Southeast Asia Tandem Switching Centers, Final Report, pp. 11-12.

3. Ibid., p. 9.

CHAPTER IV

THEATER INFLUENCES IN THE WESTERN EUROPEAN, SOUTHWEST ASIA AND PACIFIC THEATERS

With the richness of the lessons learned from Historical Approaches in Chapter II and the communications views in Chapter III, the next step is to address the three selected theaters to see how they might further influence a theater-wide communications system. The European and Pacific theaters are well known and the United States has gained much experience in these theaters. The Southwest Asia theater does not have a US infrastructure or troop elements on land based facilities, but much planning and studying has been accomplished for the theater. Since the purpose of this chapter is primarily to see what influences in each theater can affect the role of a theater-wide communications system, only the more pertinent points are addressed. Some points are common to all theaters. For example, current capabilities never seem to be able to satisfy all of the requirements for communications. Additionally, some things never materialize to the degree the communications community would like, such as, survivability, endurability, grade of service and wartime use. Factually, the requirements are sometimes not understood and overly complex user area systems are fielded which quickly consume more capacity. It is often a difficult problem in communications to really understand the nature of the overall picture. What theater influences should be understood before defining possible Army roles?

CHAPTER III

THEATER-WIDE COMMUNICATIONS SYSTEM

This chapter focuses on the communications and electronics capabilities in a theater-wide system from two alternatives. The first alternative is the desire of the Army to ensure better command and control of its forces with the Army component commander having operational control of the resources. Interfaces would be effected where necessary. The second alternative is to examine an integrated and joint theater-wide system with other MILDEPs, primarily the Air Force, in which operational control would not be totally the purview of a single component in the theater. Interfaces would be fewer in an integrated system, and the treatment of joint operations and combined operations would differ in operation and support of the theater-wide communications system.

These theater-wide communications are the key to effective command and control. If communications is a weak link, then superiority in the C^2I functions would still have little effect. It is better to have communications capabilities which can support fair C^2I capabilities than to have superior C^2I capabilities without communications.

Figure III-1 is a pictorial depiction of previous discussions on the communications within the theater. The Defense Communications System brings the long-haul connectivity into the theater. The theater-wide communications system ensures a survivable and endurable capability among the theater commander, component commanders, joint elements and any designated elements such as logistics, personnel and support centers

COMMON ELEMENTS

Post Telephone and Telegraph (PTT)

The PTT is an organization which plays key roles in communications systems. The United States leases circuits where military circuits are not available, and then, for survivability and diversity, leases circuits where military circuits are available. One must recall that during World War II in Western Europe, telephone calls generally were always possible, for example, between Berlin and Paris. The switching and transmission facilities of many PTTs far exceed anything the United States would or could provide in the more developed countries. It would appear therefore that much more utilization of the PTT facilities, would be an advantageous way, certainly in the near term, to enrich the theater-wide communications system. While the annual, recurring charges might appear expensive in comparison with use of DOD systems there, they are usually not and would greatly improve the two factors of survivablity and endurability. The increased use of PTT facilities stands tall amongst all the other elements.

Allied Systems

The use of allied systems is a well studied capability. This paper is not going to describe the many systems of our allies which could be used when agreements can be reached. Next to the PTT facilities, however, this common element is also a valuable one, particularly in the European and Pacific theaters. Interconnections are usually small in number and provide diversity. In Europe there are systems of individual allies plus the systems of NATO as well. Standardized Agreement (STANAG) 5104 is the document which depicts how national, tactical, switched telecommunications systems are to be interfaced with the NATO

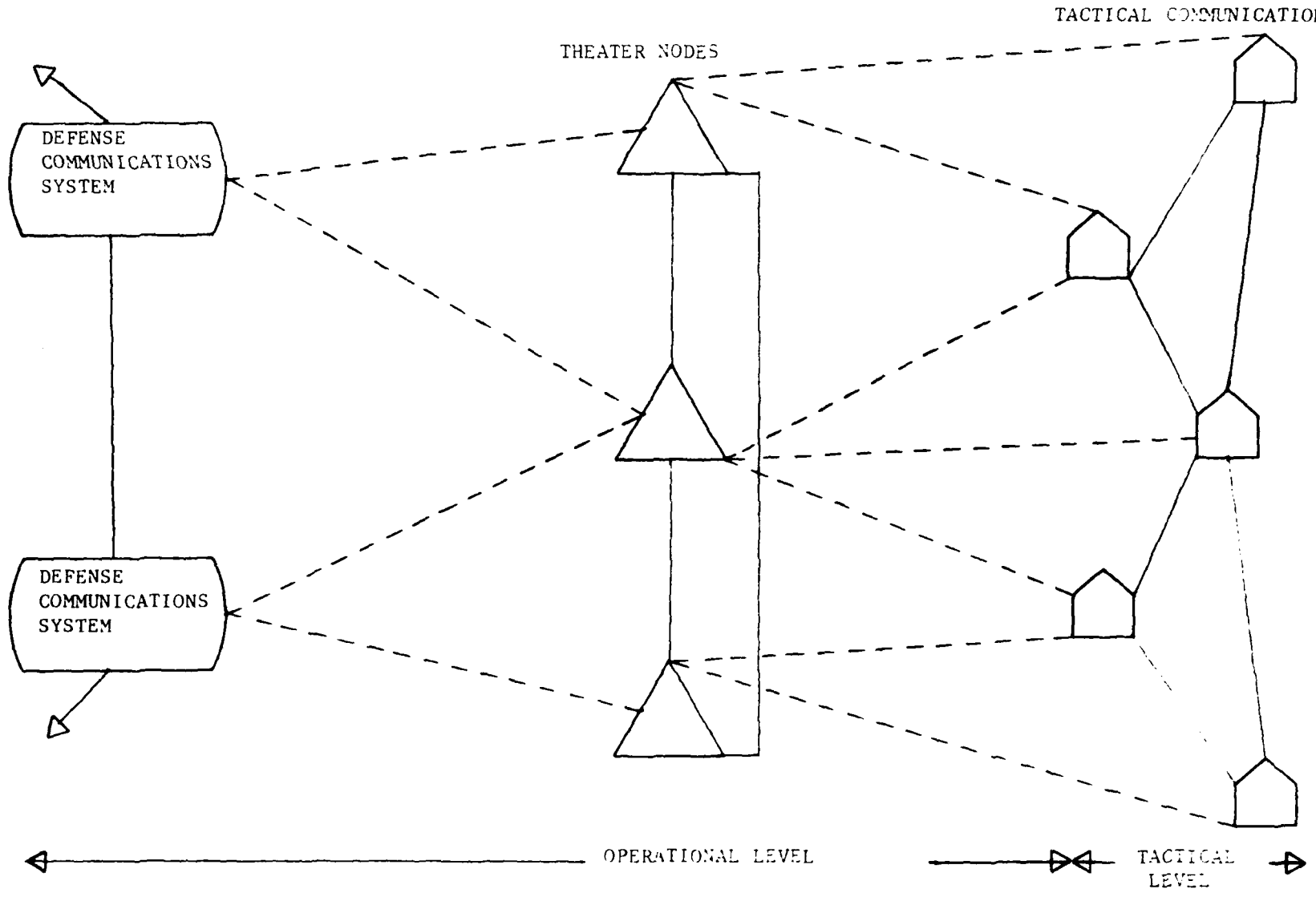

FIGURE III-1. THEATER COMMUNICATIONS

Integrated Communications System. In the Pacific theater, the Republic of Korea would be an appropriate example. While this element receives much attention, little has been accomplished on the interconnection of automatic, switched systems.

Circuit Swapping

Circuit swapping is the exchanging of the use of a circuit on one system for use on another system. The use of circuit swapping is usually between a US system and a NATO System or an allied system. It should continue as an active item so the richness of media diversity can be increased, even though the number of circuits is usually quite small.

Host Nation Support

Host Nation Support in numerous communications functions can be the source of many and varied advantages. These should continue to be pursued wherever and whenever possible. The provision of communications, whether it be telephone service or just a cable connection to a US microwave station, is always of assistance in path diversity.

Circuit Costs

The bill for leased circuits is always going to look high. Perhaps that is the reason that the connection of an additional path between an AUTOVON switching center in the United States and one in Europe still requires approval by the Office of the Joint Chiefs of Staff. This common element, however, must stand out as a proper means of establishing a survivable and endurable communications system. It is mentioned separately as an element, even though it is usually in conjunction with a NATO or allied system, because of the tendency to not want to face increased rental charges.

which may be required. Before developing the two aforementioned alternatives, the following points are common to both.

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The following points are actually common to both alternatives, and are listed here to avoid repetition:

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Communications Traffic

The types of communications traffic is the same in the theaters. Voice and data traffic is a requirement in both clear and secure modes. Eventually, the goal of a totally secure system might be achieved. Meanwhile, bulk encryption of transmission paths can assist in the denial of foreign sensors to lucrative intelligence on otherwise non secure paths.

Alternate Routing/Media Diversity

This element continues to be a tried and proven one. Automatic switching centers select alternate paths when primary ones are busy or out of service. Non switched systems often utilize redundant transmission facilities. The different types of transmission media enrich the diversity of alternate paths by alternate facilities. This element must continue to receive significant attention. An example would be to enhance the use of high frequency (HF) radio in the US communications systems. Many improvements exist today in quality over previous generations of equipment. It is also important to recognize that in the eventuality of an electromagnetic pulse (EMP) from a nuclear burst, HF radio would be the first type of transmission media to recover its capability.

Physical Security /Hardening

Physical security is excellent at many communications sites, but at many others much improvement is needed. Hardening of facilities against blast is accomplished on too small a scale for the communications systems. Soviet doctrine calls for the Operational Maneuver Group

As noted in the Statement of the Problem, a communications system is needed within a theater to permit the CINC to exercise command and control effectively. This alternative is rather a polar extreme of any "joint" system because of the maximization of Army control. The Army is the primary land force and is the component which must close with the enemy and occupy the ground. It is only logical, then, to want to have as much as possible under operational control to support that battle. However, with AirLand Battle doctrine there is more interdependence and coordination required than before among the components, particularly between the Army and Air Force. The new requirements to "Strike Deep," "Look Deep" and "Maneuver Deep" alone reflect this point. Stated otherwise the concept of operational control might have to be less for a single component and more for a joint component approach since the establishment of the AirLand Battle doctrine.

Under this alternative, however, the Army would retain more operational control than in a "joint" system, which would be the biggest advantage. The disadvantage of course would be a higher cost and more equipment, personnel and infrastructure.

JOINT THEATER-WIDE COMMUNICATIONS SYSTEM

This alternative focuses upon an integrated, theater-wide system rather than separate systems for the components. As noted in the Statement of the Problem, work has been ongoing for several years to develop a Joint Multichannel Trunking and Switching System (JMTSS) which would fulfill the Required Operational Capability of each of the CINCs in the three theaters addressed in this study. The basis of this joint approach is to have an effective communications system for C^2I which is optimized

to move forward rapidly after the lead forces open a penetration, and their prime targets include C^2I sites and the communications which support them. Physical security and hardening are big contributors to the survivable aspect of a theater-wide system.

Reconstitution

The capacity for reconstitution of equipment and sites remains a prime contributor towards an endurable communications system. There is no doubt that at the outbreak of any war, many of the fixed facilities are expected to be severely damaged and would have to be reconstituted. Reconstitution capabilities are even more important to the existing communications systems, since there is not a high degree of survivability or endurability. The primary reasons are sparse redundancy, and fixed locations which can be easily found and targeted.

Mobile Communications

Except for the communications equipment with the tactical units, few theater assets are mobile or even transportable. The long-haul facilities are virtually all fixed. Mobile communications capabilities in the theaters can assist in increasing the degree of survivability and endurability.

Equipment Technology

The typical period of time to develop and field a militarized switching system is 10-12 years. And, hardware technology usually lags the availability of the software which will operate the system. It is a paradox that commercial equipment, which very often replicates the developing military systems and is simpler and more advanced in hardware technology, often can be operational years in advance. This begs the

within the theater rather than interfacing subsystems of the components which have been optimized at the subsystem level.

The biggest advantage would be a more homogeneous system at less cost than the first alternative of an Army theater communications system once the costs of other component systems are included. Homogeneity would apply not only to the equipment but to the procedures, network management and system control as well. The disadvantage would be having to depend on another component "to be there" and function in its role. While the network would have to have a single manager, there is not an established base for procedures, network management and system control of a joint theater-wide system. This alternative must be examined in great detail in an organizational and operational concept to include deployment of forces in varying scenarios. Otherwise, a contingency operation might occur in which a non participating force did not deploy, for example, a much needed switching center, thereby greatly inhibiting the effectiveness of the joint communications system.

Figure III-2 hypothetically illustrates additional fundamental points and advantages which are well worth considering. If the Army and Air Force each have 10 paths between two locations which have automatic switches, the traffic carrying capacity can be determined from standard traffic tables. If a joint switching center were at each location and the entire 20 paths were available, then additional traffic carrying capacity is available over the sum of 2 individual paths of 10 each (i.e., increase of 34 1/2 percent). Alternatively, if it is necessary to reduce the number of paths, then a single group of 16 paths would equal the original traffic carrying capacity with a savings of 4 paths (i.e., 20 percent savings). In addition to increased capacity, improved network management and greater capability for alternate routing of calls would

question "couldn't commercial equipment be used to meet the mission even including maintenance support and life cycle costs?" The analysis of data in this project reveals that commercial equipment could be utilized effectively, especially where the systems are of low capacity and in relatively stable locations. Various studies exist on this subject.[1] Commercial quality equipment is still in use in military systems and probably always will be. Experience reveals that systems with commercial components and perhaps some militarized components very often achieve excellent results in environmental testing especially when a proper quality assurance program is followed during the sourcing of component parts and manufacturing.[2] Some balance is possible in the provision of commercial equipment and militarized equipment in the theaters for communications systems. Having addressed the more important universal elements in the three theaters what theater unique principles apply?

EUROPEAN THEATER

The European theater with the NATO allies is the strongest single region of interest for the United States. There is much infrastructure and many troop elements plus a myriad of supporting personnel. The US presence is well evidenced. A map of Europe is included as Figure IV-1. The geographic size of the Federal Republic of Germany is approximately equivalent to the state of Oregon. On the other extreme the Southwest Asia region is larger than the entire United States. These

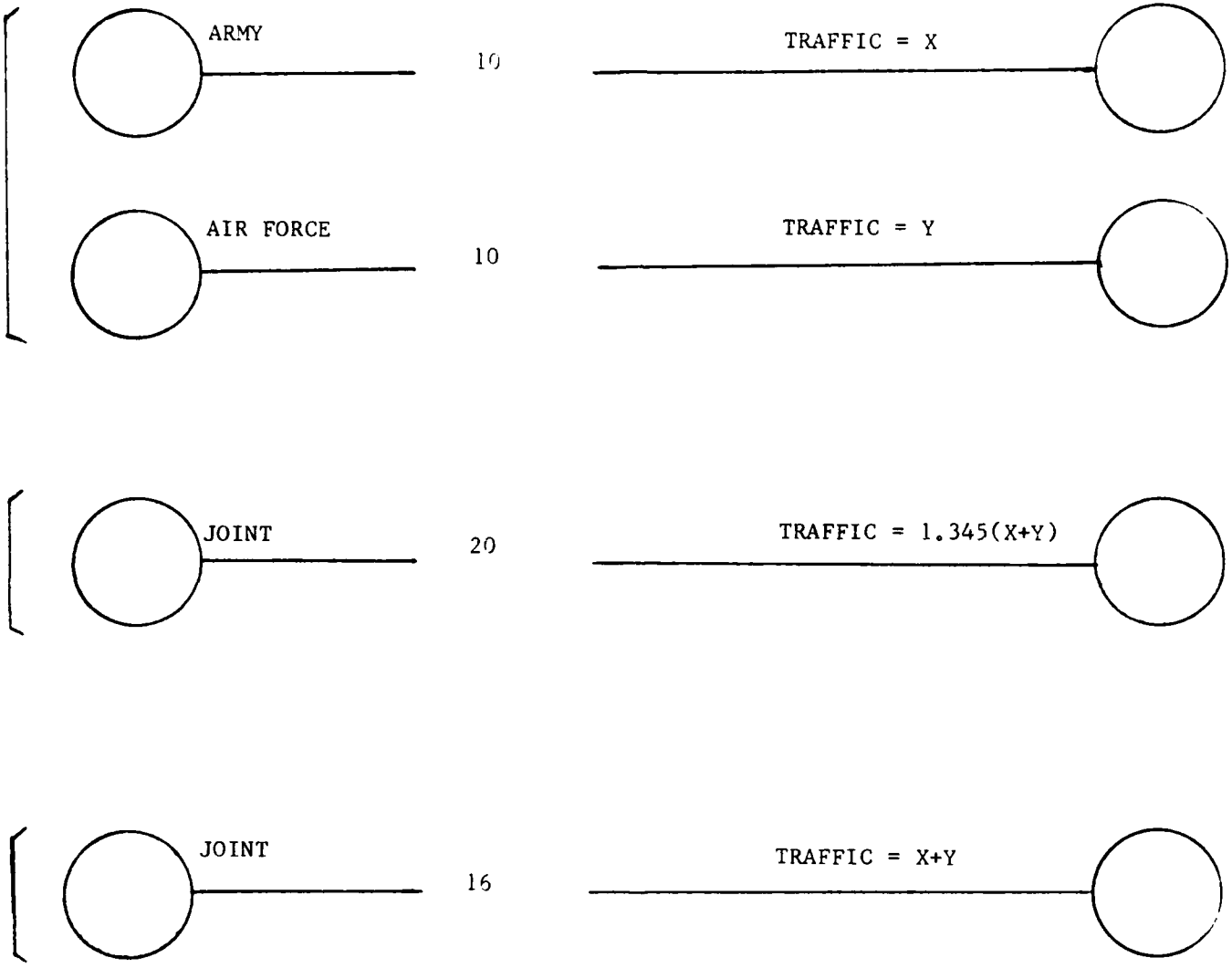

FIGURE III-3. ADDITIONAL BENEFITS OF JOINT THEATER-WIDE OPERATIONS

Europe

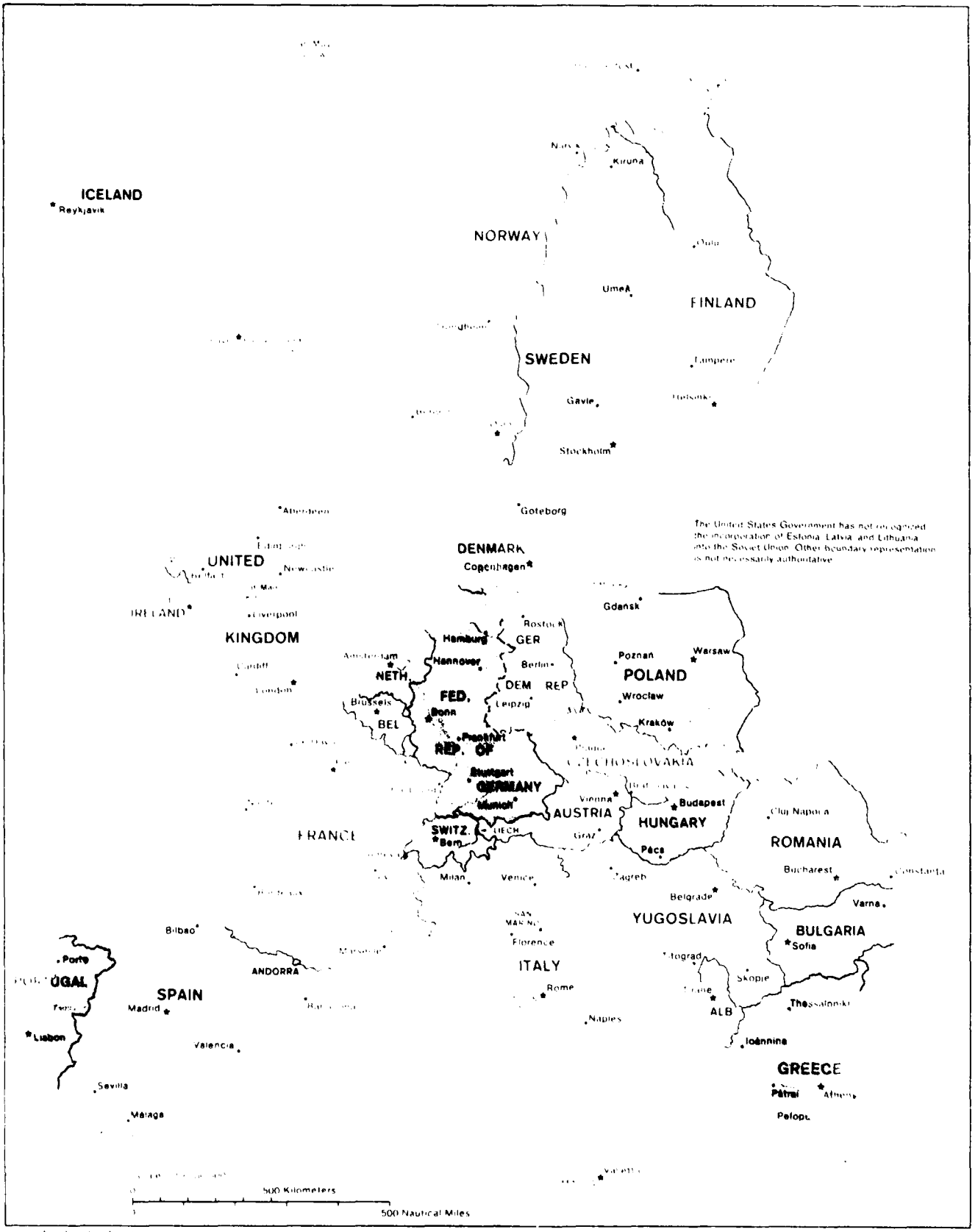

FIGURE IV-1. EUROPE

result. Also, if a joint switching center is utilized, then smaller user areas, which are homed on the joint switching center, would not have to be compatible with each other in signaling and transmission as long as each were compatible with the joint switching center. In the case of separate Army and Air Force switching centers, they would each have to be compatible with each of their respective user areas and with each other. In other words, some simplification of interfaces occurs with the operation of the joint switching center.

comparisons in size are often surprising, but in communications systems the distances and the terrain/climate are crucial considerations.

Most of the systems in place or which are being provided under the European Telephone System are fixed plant, commercial type systems. These sites are peacetime locations only, for many personnel, but the backbone system could be used in wartime until disrupted. It is this expected wartime disruption that reinforces the need for a survivable and endurable theater-wide communications system. As developed in the Common Elements, the following should be pursued strongly: PTT, allied systems, physical security/hardening, reconstitution and mobile communications. However, additional equipment is needed, as would be depicted in a communications architecture, to show how to implement the wartime aspect of the theater-wide system. In one interview, an engineer noted that he must consider somewhere on the order of ten thousand user need-lines/circuits for a theater-wide system.[3] Actually, it depends upon the perception of different organizations as to what is required in the number of paths. These paths, of course, include communications requirements for command and control, common user, special purposes, administration, logistics, and intelligence.

Even with prepositioned equipment, which can also be targeted, lift and logistics capabilities still remain crucial in the European theater should hostilities commence. The additional communications capability would necessitate additional people, also "in short supply."

The socio-politico-economic ties with Western Europe are stronger than with any other region. The roots of much of the US heritage is there, and our allies are practicing democracies. For the foreseeable future the United States will continue as a partner in the alliance.

CHAPTER IV

THEATER INFLUENCES IN THE WESTERN EUROPEAN, SOUTHWEST ASIA AND PACIFIC THEATERS

With the richness of the lessons learned from Historical Approaches in Chapter II and the communications views in Chapter III, the next step is to address the three selected theaters to see how they might further influence a theater-wide communications system. The European and Pacific theaters are well known and the United States has gained much experience in these theaters. The Southwest Asia theater does not have a US infrastructure or troop elements on land based facilities, but much planning and studying has been accomplished for the theater. Since the purpose of this chapter is primarily to see what influences in each theater can affect the role of a theater-wide communications system, only the more pertinent points are addressed. Some points are common to all theaters. For example, current capabilities never seem to be able to satisfy all of the requirements for communications. Additionally, some things never materialize to the degree the communications community would like, such as, survivability, endurability, grade of service and wartime use. Factually, the requirements are sometimes not understood and overly complex user area systems are fielded which quickly consume more capacity. It is often a difficult problem in communications to really understand the nature of the overall picture. What theater influences should be understood before defining possible Army roles?

Occasionally the "divorce" of the United States and NATO is discussed;[4] this eventuality is hardly likely.

It appears the projected topics of interest for this theater would be the continuation of implementation of the European Telephone System, enrichment of the peacetime network, development of a communications architecture for user needlines in a wartime situation and an eventual establishment of a theater-wide communications system. Physical security and hardening would enhance survivability. Reconstitution and the establishment of additional communications capabilities would enhance endurability. Now let us look at a theater which is a polar extreme in US infrastructure and presence to the European theater.

SOUTHWEST ASIA THEATER

The Southwest Asia theater is more unique among the three theaters in that US military presence is essentially non existent on the ground. The US Central Command has responsibility for this theater and would have to carry with it everything it would need to fight if deployed to this theater. Communications capabilities would have to be of a mobile or transportable type. Figure IV-2 shows the expanse of the terrain in this region. Sand is a bitter enemy of communications equipment, and the temperature fluctuations between night and day are extreme. The atmosphere can affect transmission propagation in different ways because of thermal inversion layers in this type of environment.

Some commercial communications systems exist, but they are limited in both geographic location and technical capability. Truly, it continues to be a matter of "taking it with you" for the near term. Since there is not a US presence in force structure, inductive reasoning must be used to project communications requirements in this theater.

COMMON ELEMENTS

Post Telephone and Telegraph (PTT)

The PTT is an organization which plays key roles in communications systems. The United States leases circuits where military circuits are not available, and then, for survivability and diversity, leases circuits where military circuits are available. One must recall that during World War II in Western Europe, telephone calls generally were always possible, for example, between Berlin and Paris. The switching and transmission facilities of many PTTs far exceed anything the United States would or could provide in the more developed countries. It would appear therefore that much more utilization of the PTT facilities, would be an advantageous way, certainly in the near term, to enrich the theater-wide communications system. While the annual, recurring charges might appear expensive in comparison with use of DOD systems there, they are usually not and would greatly improve the two factors of survivablity and endurability. The increased use of PTT facilities stands tall amongst all the other elements.

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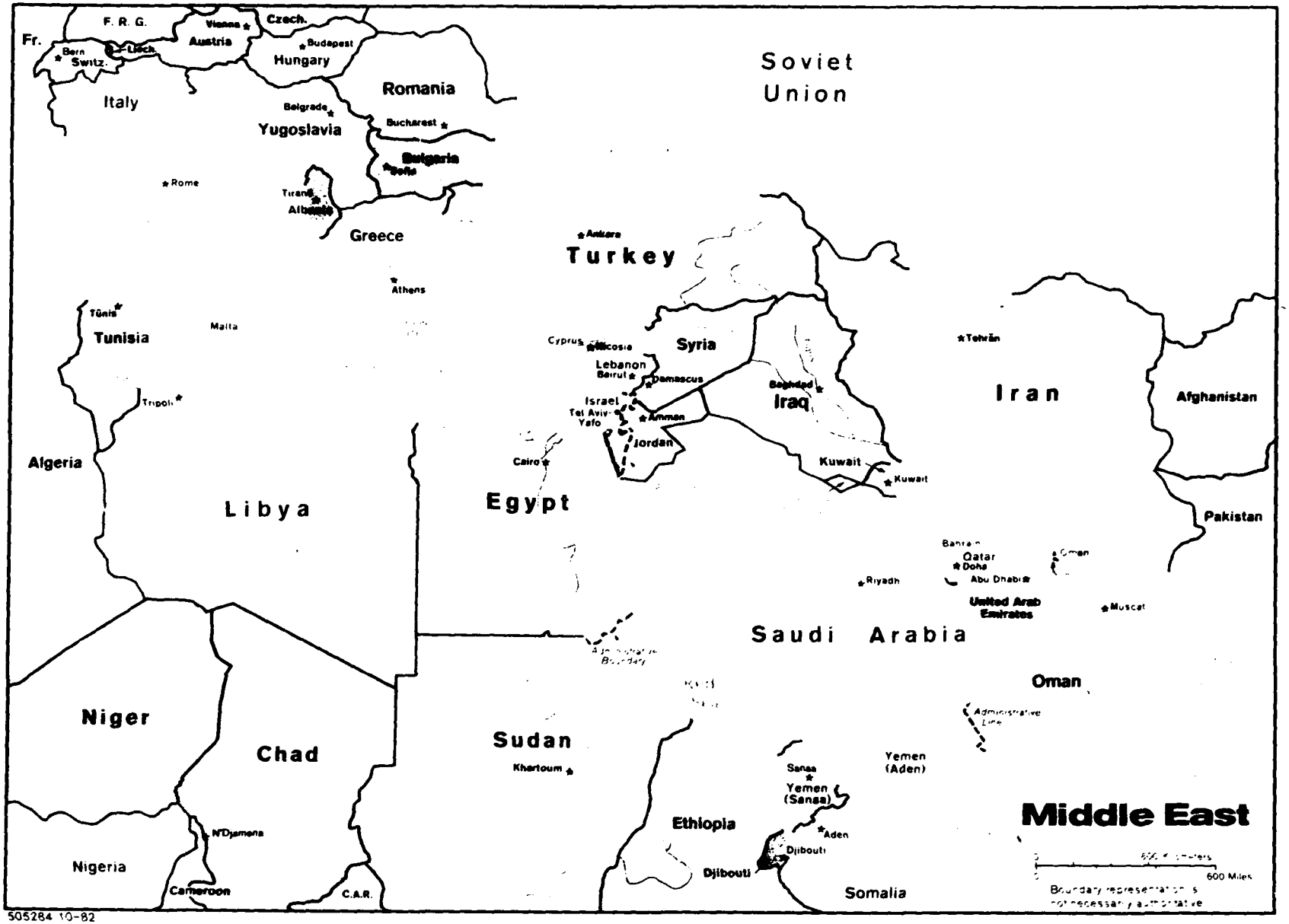

FIGURE IV-2. SOUTHWEST ASIA

Integrated Communications System. In the Pacific theater, the Republic of Korea would be an appropriate example. While this element receives much attention, little has been accomplished on the interconnection of automatic, switched systems.

Circuit Swapping

Circuit swapping is the exchanging of the use of a circuit on one system for use on another system. The use of circuit swapping is usually between a US system and a NATO System or an allied system. It should continue as an active item so the richness of media diversity can be increased, even though the number of circuits is usually quite small.

Host Nation Support

Host Nation Support in numerous communications functions can be the source of many and varied advantages. These should continue to be pursued wherever and whenever possible. The provision of communications, whether it be telephone service or just a cable connection to a US microwave station, is always of assistance in path diversity.

Circuit Costs

The bill for leased circuits is always going to look high. Perhaps that is the reason that the connection of an additional path between an AUTOVON switching center in the United States and one in Europe still requires approval by the Office of the Joint Chiefs of Staff. This common element, however, must stand out as a proper means of establishing a survivable and endurable communications system. It is mentioned separately as an element, even though it is usually in conjunction with a NATO or allied system, because of the tendency to not want to face increased rental charges.

Thus far a baseline has been established in terms of a communications architecture/system design which has been completed by the Defense Communications Agency in response to tasking by the Joint Chiefs of Staff. [5] For a particular scenario it could be shown that in excess of one thousand paths or user needlines would be required in a theater-wide system of 24 sites. This number of sites is not very many when one considers the geographic size of the region. A requirement for over one thousand personnel can be identified just for operations and maintenance of the equipment if, for example, the TRI-TAC family of equipment is to be utilized.

Of course scenarios can be varied and quantities can be changed, but in any scenario, the lift to transport the necessary equipment and personnel into the theater is obviously extensive. The number of paths, people and sites can be halved or doubled depending upon the parameters which are used in the analysis. The point in depicting these quantities is to establish an order of magnitude relative to the other theaters.

It appears the projected topics of interest for this theater would be the formulation of a communications capability which could be established in the theater if forces were deployed and supplemented in only a minor way by the common elements which have been discussed. The lesser the degree of survivability and endurability, the fewer the requirements for equipment, personnel and lift. A concept paper for AirLand Battle doctrine has been developed which deals in more detail with this type of theater. [6] As a tie in to the European and Pacific theaters, the mobile or transportable equipment in this theater could be the same type which might be used for reconstitution in all theaters.

Communications Traffic

The types of communications traffic is the same in the theaters. Voice and data traffic is a requirement in both clear and secure modes. Eventually, the goal of a totally secure system might be achieved. Meanwhile, bulk encryption of transmission paths can assist in the denial of foreign sensors to lucrative intelligence on otherwise non secure paths.

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Physical Security /Hardening

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PACIFIC THEATER

The Pacific theater is also a region of strong interest to the United States. Figure IV-3 depicts the geography. Of note are the long distances over water between most of the land areas of interest. The Republic of Korea is a vital land area. Japan is a large trade partner and heavily dependent on oil from Southwest Asia, as are European allies. Various air fields and naval facilities exist throughout the theater.

There is an infrastructure in place which provides a communications capability. The Defense Communications System is used extensively to connect users between the countries and back to the United States. The theater-wide communications system would look largely towards an enhancement of these paths to ensure survivability and endurability plus sufficient enhancements within the countries for extension of the theater-wide system to the tactical communications equipment and other echelons above the corps level. As developed in the common elements, the following should be pursued strongly: PTT, allied systems, physical security/hardening, reconstitution and mobile communications. Additional equipment is needed, as would be depicted in a communications architecture, to enhance the peacetime and the wartime aspects of a theater-wide system. In one interview, an engineer noted that he expects somewhere on the order of almost three thousand user needlines/circuits for a theater-wide system.[7] Again, this number could halve or double this quantity depending upon one's perspective.

It appears the projected topics of interest for this theater would be the development of a communications architecture for user needlines

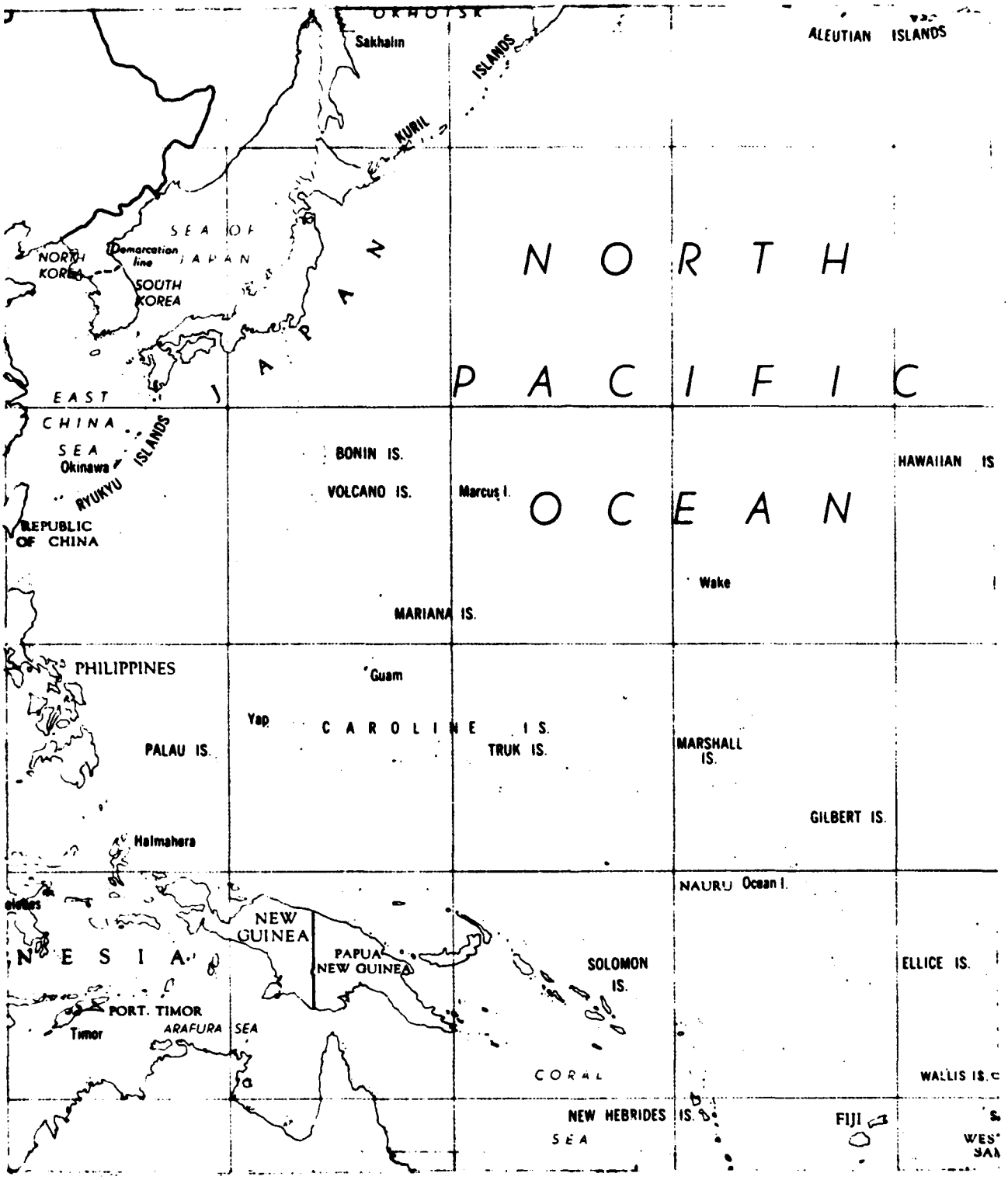

FIGURE IV-3. PACIFIC

to move forward rapidly after the lead forces open a penetration, and their prime targets include C^2I sites and the communications which support them. Physical security and hardening are big contributors to the survivable aspect of a theater-wide system.

Reconstitution

The capacity for reconstitution of equipment and sites remains a prime contributor towards an endurable communications system. There is no doubt that at the outbreak of any war, many of the fixed facilities are expected to be severely damaged and would have to be reconstituted. Reconstitution capabilities are even more important to the existing communications systems, since there is not a high degree of survivability or endurability. The primary reasons are sparse redundancy, and fixed locations which can be easily found and targeted.

Mobile Communications

Except for the communications equipment with the tactical units, few theater assets are mobile or even transportable. The long-haul facilities are virtually all fixed. Mobile communications capabilities in the theaters can assist in increasing the degree of survivability and endurability.

Equipment Technology

The typical period of time to develop and field a militarized switching system is 10-12 years. And, hardware technology usually lags the availability of the software which will operate the system. It is a paradox that commercial equipment, which very often replicates the developing military systems and is simpler and more advanced in hardware technology, often can be operational years in advance. This begs the

in a wartime situation. Physical security and hardening would enhance survivability. Reconstitution and the enhancement of existing communications capabilities would aide endurability. The reconstitution can be related to the same type of equipment for the same purpose in the other two theaters.

question "couldn't commercial equipment be used to meet the mission even including maintenance support and life cycle costs?" The analysis of data in this project reveals that commercial equipment could be utilized effectively, especially where the systems are of low capacity and in relatively stable locations. Various studies exist on this subject.[1] Commercial quality equipment is still in use in military systems and probably always will be. Experience reveals that systems with commercial components and perhaps some militarized components very often achieve excellent results in environmental testing especially when a proper quality assurance program is followed during the sourcing of component parts and manufacturing.[2] Some balance is possible in the provision of commercial equipment and militarized equipment in the theaters for communications systems. Having addressed the more important universal elements in the three theaters what theater unique principles apply?

EUROPEAN THEATER

The European theater with the NATO allies is the strongest single region of interest for the United States. There is much infrastructure and many troop elements plus a myriad of supporting personnel. The US presence is well evidenced. A map of Europe is included as Figure IV-1. The geographic size of the Federal Republic of Germany is approximately equivalent to the state of Oregon. On the other extreme the Southwest Asia region is larger than the entire United States. These

CHAPTER IV

ENDNOTES

1. The author of this study project was a past focal point on a contract between the Defense Communications Agency and the MITRE Corporation, Contract Number F19628-82-C-0001. In this contract various types of commercial communications equipment were surveyed such as switching centers, tropospheric scatter radio, network control and system management. Such equipment can be found to be technically feasible but with concerns on encryption, digital interfaces, training for operations and maintenance and logistical support. However, the advantageous side includes off-the-shelf equipment, updated technology, proven capability and relatively low cost when compared with militarized systems.

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Europe

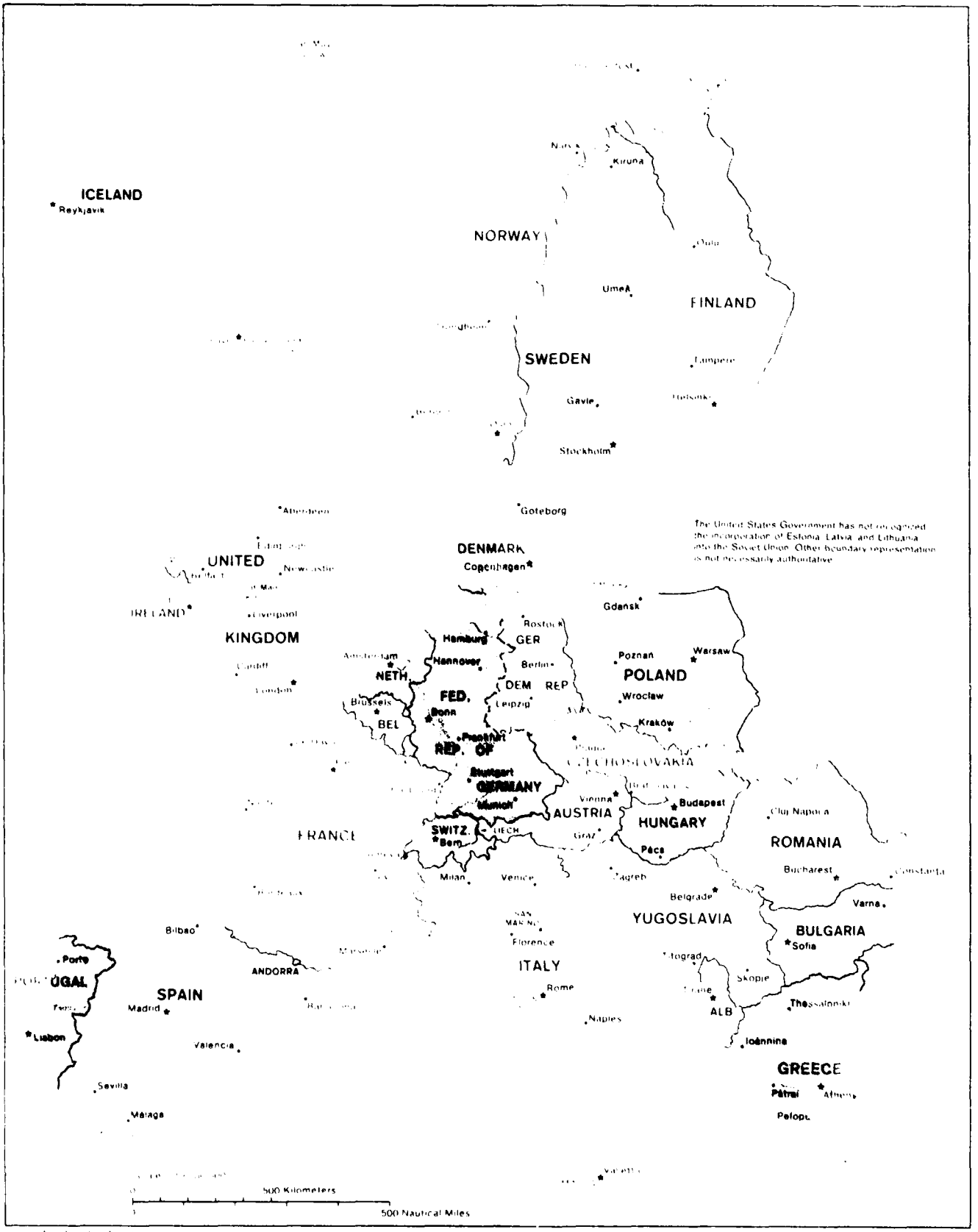

FIGURE IV-1. EUROPE

CHAPTER V

ARMY ROLE FOR COMMUNICATIONS WITHIN THE THEATER

The intent of Chapter V is to weave the thread through previous chapters and point towards the conclusions and recommendations in the next and last chapter. Recall from the Statement of the Problem in Chapter I that the basic problem is simply that doctrine and communications systems requirements cannot be effectively supported by the existing communications capabilities. This fact plus the future need of the AirLand Battle concept and the themes of survivable and endurable communications from Presidential Directives 58 and 59 further compound this shortfall into the mid term future.

Before one can crystallize possible roles for the Army, it is first necessary and very important to assess the past experience in the selected theaters in Chapter II. The factual results emerge that the Army continues to provide the bulk of the switching and transmission capabilities because it is the larger and greatly dispersed ground force. The Air Force is the other primary contributor. Air Force switching centers are typically located on Air Force bases with only some remote, backbone sites. Air Force user needlines are generally fewer in number and at fewer locations. The European Telephone System, for example, has an overwhelming number of Army locations in comparison with Air Force locations.

Well, what if there is a lot of water as in the Pacific? The results emerge in the Pacific theater that the Army requirements exist in more locations where those ground forces are dispersed. As an

comparisons in size are often surprising, but in communications systems the distances and the terrain/climate are crucial considerations.

Most of the systems in place or which are being provided under the European Telephone System are fixed plant, commercial type systems. These sites are peacetime locations only, for many personnel, but the backbone system could be used in wartime until disrupted. It is this expected wartime disruption that reinforces the need for a survivable and endurable theater-wide communications system. As developed in the Common Elements, the following should be pursued strongly: PTT, allied systems, physical security/hardening, reconstitution and mobile communications. However, additional equipment is needed, as would be depicted in a communications architecture, to show how to implement the wartime aspect of the theater-wide system. In one interview, an engineer noted that he must consider somewhere on the order of ten thousand user need-lines/circuits for a theater-wide system.[3] Actually, it depends upon the perception of different organizations as to what is required in the number of paths. These paths, of course, include communications requirements for command and control, common user, special purposes, administration, logistics, and intelligence.

Even with prepositioned equipment, which can also be targeted, lift and logistics capabilities still remain crucial in the European theater should hostilities commence. The additional communications capability would necessitate additional people, also "in short supply."

The socio-politico-economic ties with Western Europe are stronger than with any other region. The roots of much of the US heritage is there, and our allies are practicing democracies. For the foreseeable future the United States will continue as a partner in the alliance.

example, in Korea there are many Army switching and transmission locations with fewer Air Force locations. The Marine and Navy requirements, of course, are less in user needlines and at fewer locations.

For the small number of switching centers in the long-haul AUTOVON and those that existed in the Southeast Asia Tandem Switching System, the Air Force had essentially equal and greater roles, respectively. However, in the theater-wide communications system, the results show the larger quantities of Army needs and sites. Historically then, one concludes that the Army must do a lot of "taking care" of itself within theaters and within concentrated regions within a theater, such as Korea. The look at Southwest Asia again brings home the same point. Does this mean the Army must carry a larger burden for the infrastructure, equipment, personnel and logistics? Historically, yes.

Chapter III views an Army Theater-Wide Communications System and a Joint Theater-Wide Communications System. It reflects there are great benefits and advantages for savings in all areas, especially cost, when a joint system is utilized. Whether an Army system or a joint system, the Army has more people on the ground in the theaters. Does this mean the Army must pay the most? Probably. However, at this point one might conclude that the Army should be less of a contributor or participant in the long-haul Defense Communications System and other defense-wide systems and bear the brunt of the theater-wide systems. Such a proposal tends to have a lot of merit in comparison with extensive fractionalization of subsystems within the worldwide systems. It is only another alternative, however, and not a recommendation. Simply stated, the Military Departments must take a view 10-15 years hence and consider all the alternatives before buying equipment and trying to implement systems.

Occasionally the "divorce" of the United States and NATO is discussed;[4] this eventuality is hardly likely.

It appears the projected topics of interest for this theater would be the continuation of implementation of the European Telephone System, enrichment of the peacetime network, development of a communications architecture for user needlines in a wartime situation and an eventual establishment of a theater-wide communications system. Physical security and hardening would enhance survivability. Reconstitution and the establishment of additional communications capabilities would enhance endurability. Now let us look at a theater which is a polar extreme in US infrastructure and presence to the European theater.

SOUTHWEST ASIA THEATER

The Southwest Asia theater is more unique among the three theaters in that US military presence is essentially non existent on the ground. The US Central Command has responsibility for this theater and would have to carry with it everything it would need to fight if deployed to this theater. Communications capabilities would have to be of a mobile or transportable type. Figure IV-2 shows the expanse of the terrain in this region. Sand is a bitter enemy of communications equipment, and the temperature fluctuations between night and day are extreme. The atmosphere can affect transmission propagation in different ways because of thermal inversion layers in this type of environment.

Some commercial communications systems exist, but they are limited in both geographic location and technical capability. Truly, it continues to be a matter of "taking it with you" for the near term. Since there is not a US presence in force structure, inductive reasoning must be used to project communications requirements in this theater.

Chapter IV looks at each of the selected theaters so the previous ideas do not get lost in theory. One finds that there are many common elements in each theater which can be considered. Most of the elements are not theater unique but quite universal in principle. Also, the results reveal that much has been neglected since the systems are generally built for peacetime use. Stated otherwise, current systems are mostly in fixed facilities, with little real redundancy or reconstitution capabilities. The systems are not considered very survivable or endurable. Future planning is increasing the items which must be considered in future implementations. Another result from the theater look is that a single Military Department could emerge as the one primarily responsible for a theater. Another result is that each theater could be shared by the Military Departments. Balances could be made among the peacetime system, the wartime system, and the long-haul system. Tactical, organic units, of course, provide their own communications equipment at corps and below, or equivalent.

The original stated intent of this study project is to establish a baseline of understanding on theater communications so one or more roles for the Army might be viewed. The alternatives considered can be utilized in a communications architecture/system design to point the way towards an implementation plan which would be suitable, feasible and acceptable. The old three legged stool, (i.e., military objective, military strategic concept and military resources) must again be balanced with an acceptable level of risk.

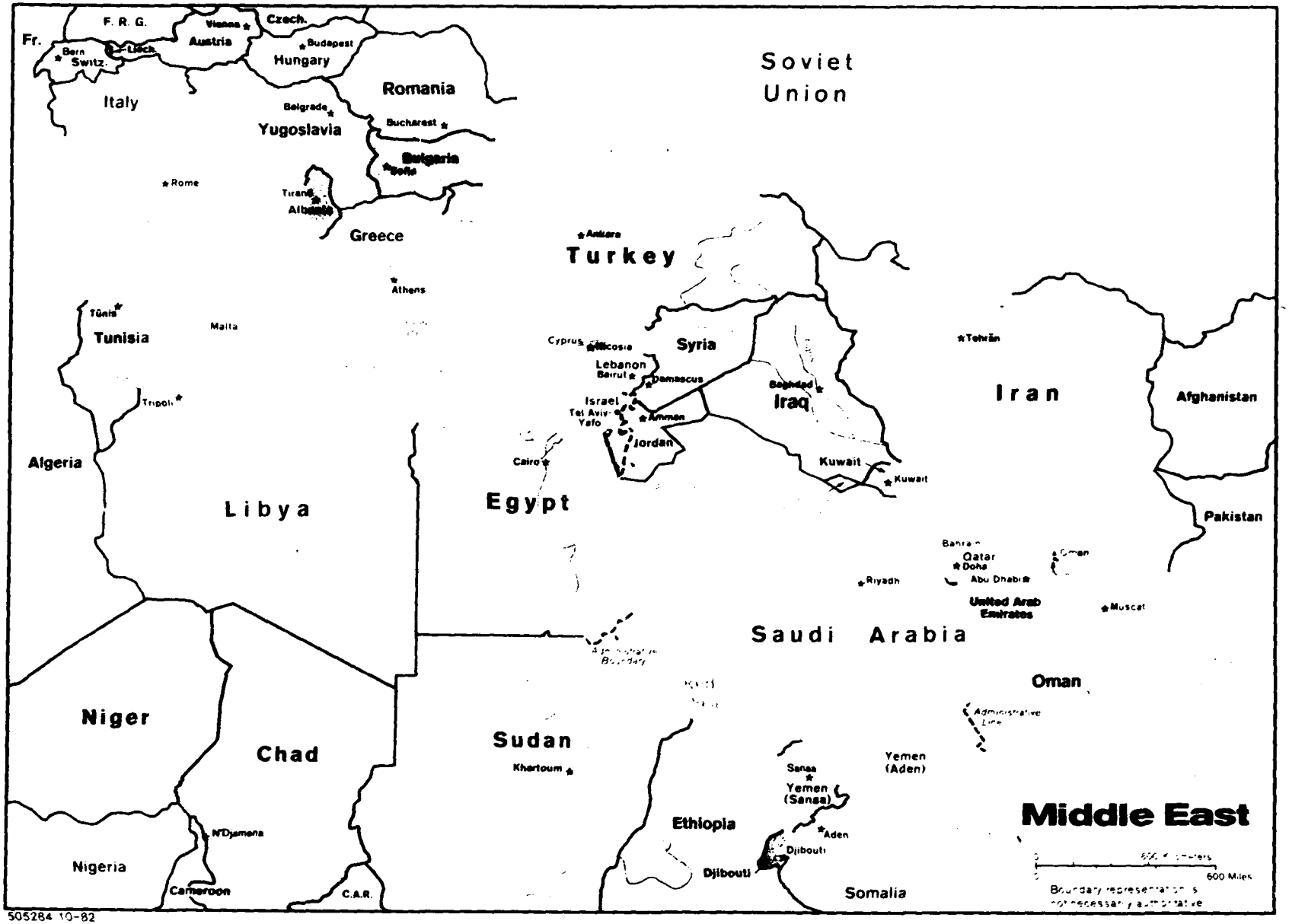

FIGURE IV-2. SOUTHWEST ASIA

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a summary of conclusions and recommendations of this study project. The conclusions and recommendations can thus be considered in the context of the study, and follow on work efforts can proceed from this established baseline. This format also serves to support analytic studies if one wishes to vary parts of the algorithm of thought to see if different results emerge.

STATEMENT OF CONCLUSIONS

The following conclusions regarding the theater communications systems have emerged from this study project:

- o The theater systems have evolved from the connecting together of manual switching centers into the connecting together of 2 wire automatic switching centers with a later introduction of 4 wire manual and automatic switching centers.
- o Long-haul systems have generally been of relatively small capacities with little redundant capabilities.
- o Communications sites have been established principally in the user areas rather than on backbone transmission routes.
- o Most of the switching centers have been of electro-mechanical design occasionally blended with electronic subsystems except for some equipment with tactical elements.
- o Software development typically delays implementation resulting in fielded systems not being state-of-the-art.

Thus far a baseline has been established in terms of a communications architecture/system design which has been completed by the Defense Communications Agency in response to tasking by the Joint Chiefs of Staff. [5] For a particular scenario it could be shown that in excess of

- Many switching centers have too complex a design diminishing potential operations and maintenance efficiencies.
- Wartime survivability and endurability are not generally characteristics of these systems.
- Reconstitution packages are generally not available for switching centers and transmission systems.
- Mobile communications capabilities generally do not exist at echelons above corps.
- Communications capabilities are basically single thread on long-haul systems and relatively non existent in a theater-wide system at echelons above corps, except for peacetime capabilities.
- Fielded technology has tended to lag state-of-the-art technology considerably because of program funding levels and the time taken to field the equipment.
- The Army can consider participation in a joint theater-wide communications system or the establishment of an Army only theater-wide system.
- Current realities in the selected theaters are not expected to change rapidly.
- Several Army roles are possible within the theaters.
- Communications systems must be simplified to the maximum extent possible in design and capabilities.
- There is probably much traffic which could be eliminated because it is just not that necessary.
- There is an urgent need to identify families of equipment which can be utilized that are technologically up to date.

PACIFIC THEATER

The Pacific theater is also a region of strong interest to the United States. Figure IV-3 depicts the geography. Of note are the long distances over water between most of the land areas of interest. The Republic of Korea is a vital land area. Japan is a large trade partner and heavily dependent on oil from Southwest Asia, as are European allies. Various air fields and naval facilities exist throughout the theater.

There is an infrastructure in place which provides a communications capability. The Defense Communications System is used extensively to connect users between the countries and back to the United States. The theater-wide communications system would look largely towards an enhancement of these paths to ensure survivability and endurability plus sufficient enhancements within the countries for extension of the theater-wide system to the tactical communications equipment and other echelons above the corps level. As developed in the common elements, the following should be pursued strongly: PTT, allied systems, physical security/hardening, reconstitution and mobile communications. Additional equipment is needed, as would be depicted in a communications architecture, to enhance the peacetime and the wartime aspects of a theater-wide system. In one interview, an engineer noted that he expects somewhere on the order of almost three thousand user needlines/circuits for a theater-wide system.[7] Again, this number could halve or double this quantity depending upon one's perspective.

It appears the projected topics of interest for this theater would be the development of a communications architecture for user needlines

- o More use can be made of the capabilities of PTTs and allied systems.
- o Communications requirements far exceed communications capabilities.
- o Planning approaches must be utilized for wartime systems in the theater-wide and long-haul communications.
- o Physical hardening and increased security measures should increasingly be established.
- o Capitalize more on industrial capabilities.

While other conclusions could be listed, the intent is to provide the important ones. Also, the conclusions tend to reflect those areas which need the most attention.

Most of the communications systems have done very well once in place and functioning. Crises and conflicts have seen superlative accomplishments in communications. But, there are still many deficiencies which need to be overcome from the past and many new shortfalls as doctrine and requirements change. The Department of Defense must succeed in fielding flexible, wartime capable, current, technologically sound, communications systems. Interface problems must be minimized and operations and maintenance simplified.

RECOMMENDATIONS FOR FOLLOW ON ACTIONS

There remains a need for the formulation and development of communications architectures. These architectures are not detailed implementation plans but rather road maps to assist in choosing general courses of action. Next should come the establishment of system designs. The latter actions are best accomplished by whomever accomplishes the overall systems engineering and source provision of the actual equipment.

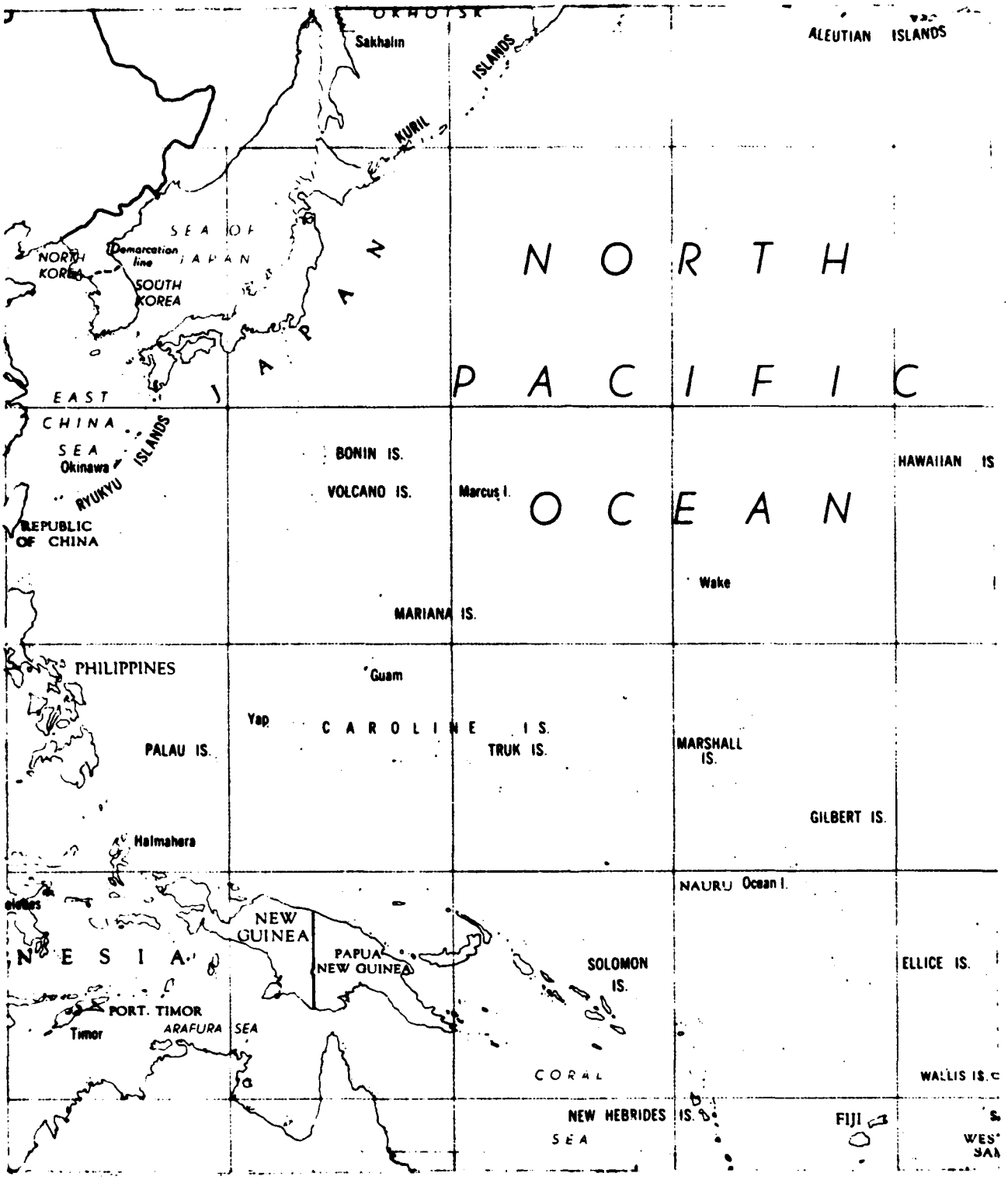

FIGURE IV-3. PACIFIC

The above sequence of actions are the general recommendations. Several specific recommendations follow for the Army:

- o Decide with other services on a joint system or Army only system by consideration of advantages, disadvantages, and cost.
- o Decide how systems might be simplified if militarized standards could be relaxed allowing for adoption of good commercial standards; and very importantly, how to field a system expeditiously.
- o Use mobile communications and reconstitution and physical hardening of sites to provide survivability and endurability.
- o Address the elimination or reduction of user needlines.
- o Proceed with communications architectures as soon as possible. Then, in conjunction with previous recommendations, accomplish a systems design and move to the expeditious fielding of the communications capabilities.

These recommendations conclude this study project. Hopefully, readers in the various professional disciplines who will influence the future of military communications will be stimulated by some of the thoughts herein.

in a wartime situation. Physical security and hardening would enhance survivability. Reconstitution and the enhancement of existing communications capabilities would aide endurability. The reconstitution can be related to the same type of equipment for the same purpose in the other two theaters.

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CHAPTER IV

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CHAPTER V

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- Many switching centers have too complex a design diminishing potential operations and maintenance efficiencies.
- Wartime survivability and endurability are not generally characteristics of these systems.
- Reconstitution packages are generally not available for switching centers and transmission systems.
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- There is an urgent need to identify families of equipment which can be utilized that are technologically up to date.

- o More use can be made of the capabilities of PTTs and allied systems.
- o Communications requirements far exceed communications capabilities.
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